

FM 5-146

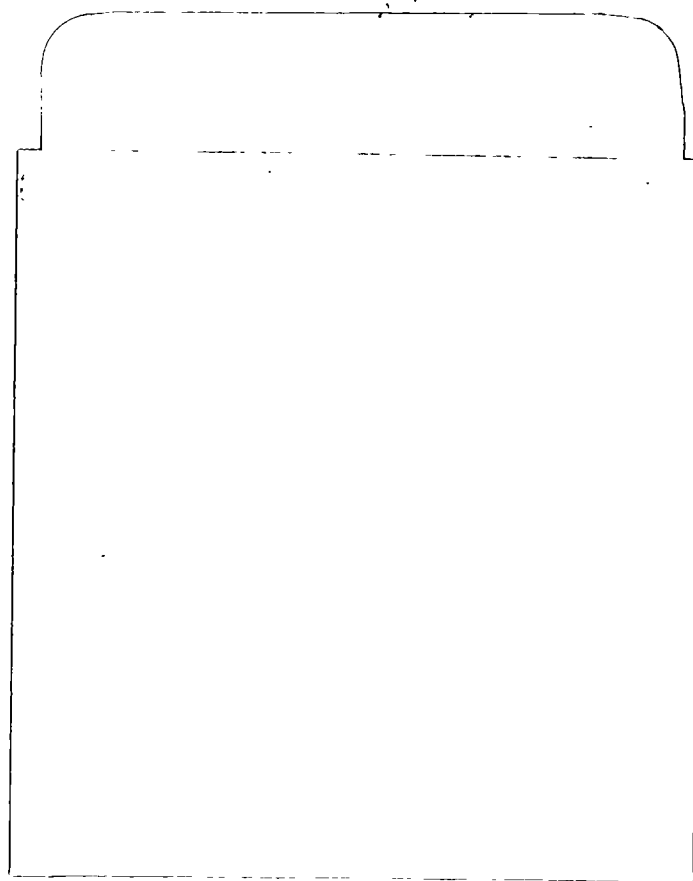
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FM 5-146

ENGINEER TOPOGRAPHIC UNITS

HEADQUARTERS
DEPARTMENT OF THE ARMY



HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 28 September 1979

ENGINEER TOPOGRAPHIC UNITS

THIS MANUAL presents doctrine and guidance on the mission, organization, capabilities, and employment of engineer topographic units. It is designed to guide staff officers and unit commanders responsible for directing and conducting topographic operations and training.

The scope of the manual includes an overview of topographic support, using equipment to be fielded under the Topographic Support System (TSS), and a detailed discussion of unit capabilities, tasks, and organization under the H-Series TOEs. The last chapter contains guidance on individual and unit training.

Fundamental topographic doctrine is found in FM 21-32. This manual is designed to be used with FM 21-32 plus the topographic technical manuals listed in Appendix A. The material presented here applies to the modern battlefield.

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**This manual supersedes FM 5-146, 9 October 1968.*

The word "he" or "his" in this publication is intended to include both the masculine and feminine genders and any exception to this will be so noted.



CHAPTER 1 Overview

GENERAL

This chapter presents a general discussion of *topographic support, operations, products, and developments*. Each area is discussed in greater detail under specific unit operations in later chapters.

TOPOGRAPHIC SUPPORT TO THE COMMANDER

The mission of the topographic battalion is to provide tactical commanders with topographic products to help them visualize terrain.

Topographic maps, services, and terrain information are vital to the combined arms team. For colonels and captains, who must see the battlefield in detail, weapons employment hinges on terrain information: cross-country movement, fields of fire, observation, cover and concealment, obstacles, key terrain, and avenues of approach. For commanding generals, success may depend on knowledge of lines of communication, airfields, ports, waterways, and urban-industrial complexes.

Topographic data bases, including maps, point-positioning information, and military geographic information and documentation (MGID), are almost entirely provided by the CONUS-based DOD Mapping, Charting, and Geodesy (MC&G) community. In the field, engineer topographic units work for commanders at theater army corps and division level to use and update these data bases by providing terrain analysis (tailored to commanders' needs) and user-oriented battlefield products, survey support, and map distribution at corps level. FM 21-32 contains a detailed discussion of topographic support.

MAPS ARE A PART OF THE WEAPON SYSTEMS

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Organization

Primary source of topographic support in the theater army area is the Engineer Topographic Battalion. Assigned to the theater army*, the battalion uses its cartographic and survey companies and terrain and other topographic teams to provide general support to corps and divisions.

The allocation of these assets in the theater is shown in figure 1-1.

*The term "theater army" used in this manual is synonymous with "echelon above corps (EAC)."

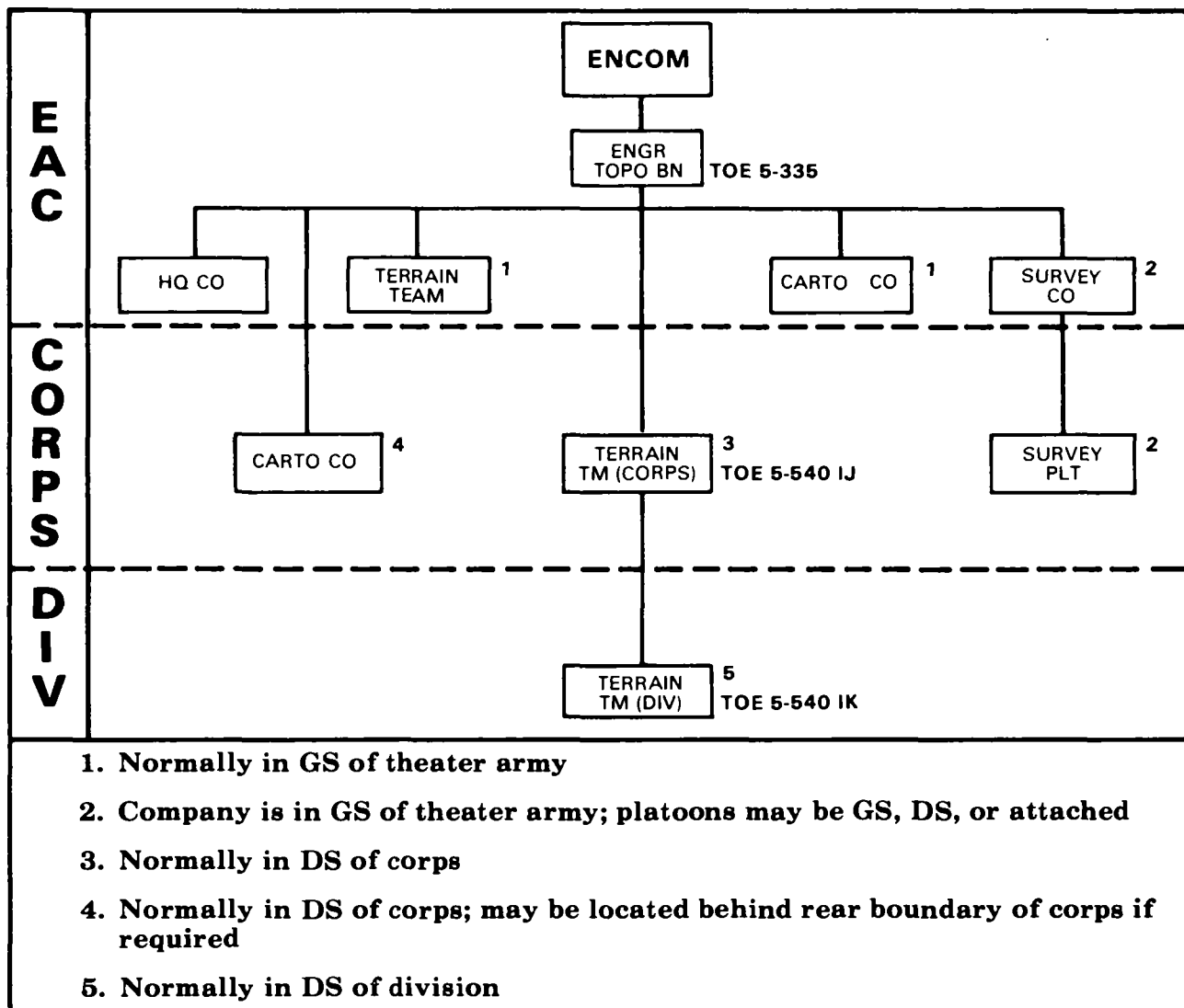


Figure 1-1. Topographic Organization, Theater Army.

Employment

Topographic units work closely with the intelligence and engineer staffs of the supported commands. Normally, the battalion is assigned to the engineer command (ENCOM) at theater army and works under the staff supervision of the ENCOM assistant chief of staff for intelligence (ACSI). The battalion headquarters company, GS cartographic company, and survey company remain in the communications zone (COMMZ).

To speed information to tactical commanders, the DS cartographic companies locate as far forward as the nature of theater operations permits. The DS terrain teams (TOE 5-540H teams assigned to the battalion) work closely with the Corps Electronic Warfare Intelligence Operations Center (EWIOC) and the division Military Intelligence (MI) battalion operations center. Some personnel are located in the EWIOC at corps.

The survey units remain in general support in the COMMZ or move throughout the theater providing direct support as needed.

Topographic units rely on supported commands for administrative, logistical, and security support. The topographic battalion is the primary source of support for topographic supplies.

Command, Control, and Liaison

The ENCOM retains operational control of the topographic battalion, and an engineer brigade may provide administrative and logistic support. The battalion headquarters commands organic and assigned topographic units and provides liaison with CONUS support agencies, the theater army staff, the ENCOM staff, and other in-theater supporting elements. Liaison also includes other military services, allied national organizations, intelligence units, and commercial mapping firms.

TOPOGRAPHIC INFORMATION ASSISTS IN INTELLIGENCE PREPARATION OF THE BATTLEFIELD

The battalion's direct support units normally work under the general staff supervision of the supported unit G2. At corps, the terrain team, except personnel located at the EWIOC, work under the special staff supervision of the engineer in his role as terrain advisor to the corps commander. The terrain team at division, besides being under the general staff supervision of the G2, is under the special staff control of the division engineer.

There are two tasking channels for the direct support units. Normally they are responsive to tasks approved by their supported unit staff supervisor (G2, or engineer) or to tasks assigned by the battalion commander. The battalion commander should use direct support unit assets without interfering with the primary mission. Usually work assigned under these conditions is on a task basis and is coordinated by prior arrangement with the supported unit staff supervisor. The battalion commander maintains normal command but not operational control of the direct support units.

In addition to performing topographic tasks, the direct support units provide the battalion with liaison to corps and division intelligence units. Other topographic teams (Chapter 3), activated to fulfill specific requirements, are assigned to the battalion and work in general or direct support roles.

TOPOGRAPHIC OPERATIONS CYCLE

**RAPID, CURRENT INFORMATION
IS THE KEY TO
TOPOGRAPHIC OPERATIONS**

The scope of topographic operations in the field has changed significantly since 1972. The formation of the Defense Mapping Agency, deactivation of base topographic battalions, implementation of new TOE series 5-335H and changed series 5-540H, all have resulted in new mapping, extensive map revision, and much of conventional survey being eliminated from the field unit's mission. Today, the topographic operations cycle normally culminates with map overprints, overlays, photomaps, and terrain intelligence products. Topographic services provide timely, battle-oriented terrain survey and map product support for theater elements. The key to topographic operations is rapid, current, and responsive information for the commander.

Production Phases

The preparation of any topographic product can be broken down to general phases. The duration or bypassing of a phase may depend on the availability of source materials, the product desired, and the preparation time available. The normal sequence of production is:

- **Collection/Evaluation of Source Materials (data base)**
- **Collection/Evaluation of Field Data or Survey Information**
- **Terrain Analysis**
- **Compilation**
- **Cartographic Operations**
 - **Editing**
 - **Reproduction**
 - **Distribution/Dissemination**

Collection/Evaluation of Source Materials

For terrain products, this phase involves the extraction of terrain information from available Military Geographic Information (MGI) data and supplementing that information with materials from all sources including remote-sensed imagery; text materials; and reports from intelligence, engineer, and tactical units. For photo-based and standard map products, collection may include the procurement of imagery, existing map bases, and geodetic control. The collected information is evaluated for accuracy, timeliness, and continuance.

**REMOTE-SENSED IMAGERY IS
A KEY PART OF
THE TOPOGRAPHIC DATA BASE**

Collection/Evaluation of Field Data or Survey Operations

The collection of field data is accomplished either by the topographic units or by other engineer and intelligence units in the area. In addition to terrain and map revision data, ground survey control may be needed, particularly in areas where photogrammetric survey methods are too inaccurate or unfeasible. In a battlefield environment or in areas of limited access, field collection may not be possible. Once information has been collected, the cycle may be interrupted to provide a verbal response to a commander's inquiry.

Terrain Analysis

Terrain analysis is performed in two distinct phases:

ANALYSIS: The extraction of basic terrain factors from imagery and other sources.

SYNTHESIS: The recombining of factors for predicting the terrain influence on operations such as cross-country movement.

Compilation

**INFORMATION COMPILED
FROM AERIAL PHOTOGRAPHY
IS THE PRIMARY MEANS
OF REVISING MAPS**

Collected, evaluated information is compiled onto an existing map or photomap base in a format designed to best meet the needs of the user in the time allocated. This phase is completed with the preparation of annotated photographs, manuscripts, overlays, or texts. To provide a fast response, these can be quickly reproduced as interim products by process photography or copiers.

Cartographic Operations

If the topographic products are intended for wide distribution, they are usually processed through the cartographic phase. This phase consists of applying photographic and drafting techniques to produce color-separated reproducibles suitable for use in offset lithographic reproduction. There are two ways of providing these reproducibles: manual drafting and scribing techniques; and the interactive graphic drafting system. The interactive graphic system (if adopted) combines the compilation and cartographic phases through the use of a computer and on-line digitizing and output devices. Other cartographic operations include the photogrammetric extension of control and the preparation of mosaics and orthophoto products.

Editing

Quality Control is a part of each of the production phases. Compilation edits are

performed by checking compiled manuscripts against source materials and the compilation standards for the product. If possible, questionable information is field checked. At the completion of the cartographic phase, the color-separated reproducibles are edited with the compilation manuscript, the product specifications and, if necessary, the source data. Usually this edit is performed on a color proof. Final quality control checks are performed on the printed products before release for distribution. The extent of individual edit steps and rejection criteria may vary due to time constraints. In all cases, the controlling criteria are accuracy and timely response.

Reproduction

The materials produced in the cartographic phases are normally reproduced by process cameras, ozalid process, or offset printing. Process photography and photomechanical processes can be used to reproduce a limited number of copies of map products and overlays. Offset printing is normally used to reproduce map products and to overprint base maps. Other tasks associated with reproduction operations are:

FIELD TOPOGRAPHIC UNITS OPERATE SINGLE-COLOR PRESSES IN THEIR REPRODUCTION MODULES

	<i>layout</i>
	<i>color proofs</i>
	<i>color key overlays</i>
	<i>platemaking</i>
	<i>bindery operations</i>

Distribution/Dissemination

The final product of topographic operations is information in the hands of the commander. When the nature of the information requires a visual format, the commander normally receives printed products. If the information can be tabulated, his questions can be answered by computer-generated output. Finally, dissemination might take the form of electrically transmitted replies to specific inquiries.

There are several systems designed to transmit this information. Standard maps are handled through a map distribution system which begins in CONUS and continues to each corps; then to divisions and below through unit distribution. Nonstandard products are handled through the same system beginning at theater army. Replies and other terrain information are disseminated through the topographic units' communications channels to the supported headquarters.

**SATELLITE (DOPPLER)
POSITIONING SYSTEMS
ARE VITAL TO
THEATER SURVEY
SUPPORT**

Survey Operations

With the advent of rapid photogrammetric control capabilities, the demand for conventional survey operations as part of the topographic operations cycle has been reduced. However, survey operations supporting weapon systems positioning, and providing a library of survey control for the theater, remain crucial to fighting the battle.

Survey operations include support of—

- *field artillery*
- *missile air defense*
- *surveillance devices*
- *communications requirements*

and

densification of existing survey nets using—

- *precise survey equipment*
- *satellite positioning*
- *inertial azimuth finders*
- *survey devices*
- *supporting computers*

—SEEING THE BATTLEFIELD—

TOPOGRAPHIC PRODUCTS AND SERVICES

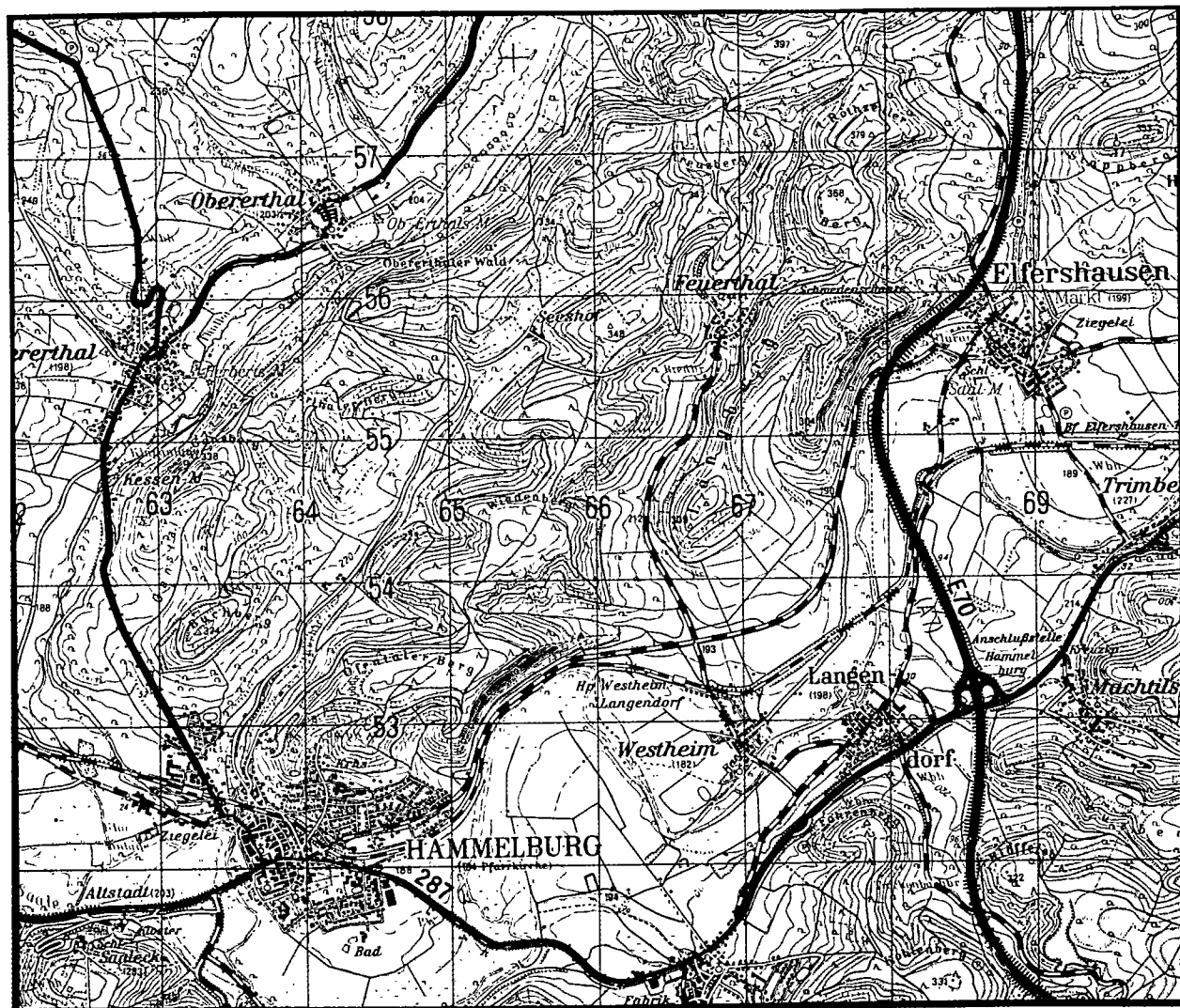
Standard Products Revision

The CONUS-based topographic community produces and revises standard products in accordance with requirements specified by the theater commander. Standard products are revised and reprinted by engineer topographic units when theater demands exceed CONUS capabilities. Standard topographic maps used in the main battle area are normally 1:250,000 joint operations graphic (JOG) line maps and 1:50,000 large scale line maps.

1:250,000
(JOG)
MEDIUM
SCALE



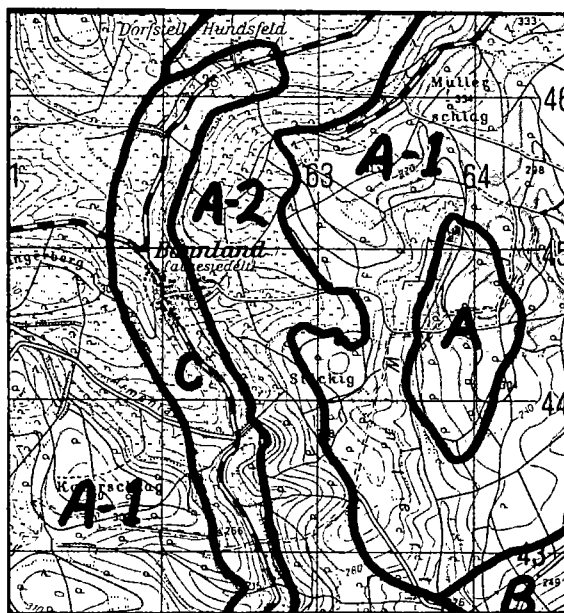
1:50,000 LARGE SCALE



Terrain Products

Standard terrain products are produced during peacetime to be used for planning and are a part of the Military Geographic Information data base. They include standard maps, previously prepared terrain studies/analyses, and other similar compositions of geographic information such as road and bridge maps. Engineer topographic units are directly involved in the peacetime production of these finished cartographic products. However, during hostilities, the main activity will be to produce quick response terrain information, special products, and services for the tactical commanders. If feasible, the appropriate data bases may be revised and updated during hostilities, but not at the cost of the tactical commander's terrain-related requirements.

TERRAIN INFORMATION OVERPRINTED ON A STANDARD TOPOGRAPHIC MAP



OVERPRINTED MAP

Special products are overlays or overprints which combine several elements of the terrain and relate the combined effect to military use or show a tactical situation. For example, weather, surface configurations, soil, and vegetation can be combined to

determine their effect on movement through an area. This data may be overprinted on a base map or shown as an overlay to an existing map.

Terrain intelligence is a detailed description and analysis of natural and cultural features within the area of operations. It is an essential part of the intelligence preparation of the battlefield (IPB). It may be provided in the form of oral advice, graphics, displays, listings, or text. For example, a location graphic with detailed bridge construction information might be supplied for a particular road segment.

Terrain intelligence is provided as quickly as possible to enable the commander to make timely decisions. Engineer topographic units are designed to respond to most inquiries within a few hours and all inquiries within 48 hours.

Photo-Based Products

Quick response is often achieved by using photo-based products. Although they are more quickly produced, they are usually less accurate (in geographic position) and more difficult to read (without cartographic enhancement) than standard line maps. Most pictomap and ortho-type products are furnished by external sources.

*Typical
photo-based
products
are:*

• <i>Annotated photographs</i>
• <i>Uncontrolled photomaps/- pictomaps</i>
• <i>Semiconrolled and controlled photomaps/pictomaps</i>
• <i>Orthophoto/orthopicto maps</i>
• <i>Overlays</i>



ANNOTATED PHOTOGRAPH

Other Products

- | |
|---|
| • Catalogs of locally produced terrain information and maps |
| • Recast maps at various scales |
| • Reproductions of captured maps |

Other Services

- | | |
|--|--|
| • Extending horizontal and vertical control into corps and division areas for the use of artillery surveyors in positioning: | - Field artillery
- Missiles
- Air defense artillery |
| • Providing a survey information center (SIC) for the theater army; and maintaining Deployable Point Positioning Data Bases (DPPDB) for the area of operations | |
| • Providing mapping survey control where required | |
| • Operating the theater map supply and distribution systems | |
| • Providing advice on topographic matters | |

DEVELOPMENTS

Army topography is rapidly changing to keep pace with the development of mapping equipment and changing battle doctrine.

This manual and FM 21-32 are the first steps in documenting these changes into workable doctrine. This doctrine is built around the following developments:

Organization

TOPOGRAPHIC DEVELOPMENTS ARE INCREASING RESPONSE CAPABILITIES

In recent years, the need to streamline existing topographic structure and organic units around the concepts of greater mobility and increased responsiveness to the tactical commander was recognized. The first step was the replacement of immobile base topographic battalions with mobile theater army topographic battalions.

The second step was the development of a new organization for the topographic battalion which streamlined the production process, increased the direct and general support available at theater army corps and division, and revitalized terrain information

support in the theater. The resultant organizations were the 5-335H and 5-540H series TOE structures.

Equipment

Development of the Topographic Support System (TSS), a collection of mapping, interpretation, and survey equipment which incorporates the latest technology into mobile, field operable modules, was another step.

The system is designed to provide the 48-hour or less response required by tactical commanders. Some features of the TSS proposed for topographic units are:

• Analytical stereoplotter
• Orthophoto production capability
• Satellite positioning systems
• Interactive graphics systems
• Inertial systems
• Photo-interpretation equipment
• Analytical Photogrammetric Positioning System (APPS)

STEAMLINED MODULES MOVE OPERATIONS TO THE FIELD

Training

Finally, the Army Training and Evaluation Program (ARTEP) for engineer topographic units has been developed concurrent with the new organization and equipment, as have the soldier's manuals and skill qualification tests (SQTs) for the topographic career management field.

The merging of these developments provides a new look for Army topography. The topographic units are responsive to the commander's information needs. They are located with the supported units and they provide the latest technology to terrain analysis. Engineer topographic units provide the eyes by which commanders can see the battlefield.

MANUALS AND TESTS REFLECT UPDATE



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CHAPTER 2

Engineer Topographic Battalion (Theater Army)

GENERAL

The engineer topographic battalion, TOE 5-335H, is organized to provide general and direct support to tactical commanders throughout the theater army area, and is normally assigned on a basis of one per theater army. It is comprised of a headquarters and headquarters company, cartographic companies, and one survey company. Each supported corps receives a cartographic company and, if required, a survey platoon in direct support. The remaining elements (which include a cartographic company) stay with the battalion in a general support role within the theater.

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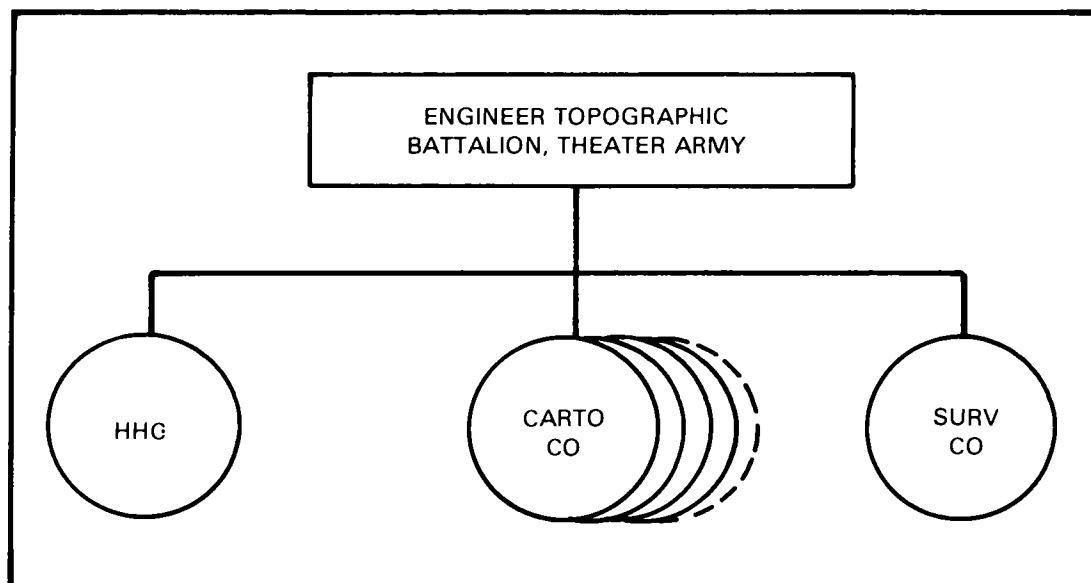


Figure 2-1. Engineer Topographic Battalion.

In addition to these organic assets, the battalion is assigned TOE 5-540H terrain teams for corps and division direct support, one team for each supported unit. Although these teams are separately organized, they function as a part of the battalion. Chapter 3 discusses the role of these teams.

The battalion is capable of providing:

**THE BROAD MISSION OF THE
TOPOGRAPHIC BATTALION IS TO
PROVIDE TOPOGRAPHIC SUPPORT
TO THEATER ELEMENTS**

Command and control of topographic elements

Survey and survey information

Map and terrain information products

Terrain intelligence and operations involving terrain data bases

Graphic reproduction and distribution

Coordination with US and allied topographic and intelligence communities

The battalion provides organizational maintenance for organic equipment. It is normally attached to an engineer brigade for logistics and administrative support.

The topographic TOE provides personnel and equipment to operate a single work shift. Multiple shift operation requires augmentation.

The battlefield tasks, structure, and operations of the battalion are discussed in detail in the following sections.

HEADQUARTERS AND HEADQUARTERS COMPANY

Structure

Battalion headquarters provides command and principal staff consisting of the battalion commander, executive officer, adjutant (S1), intelligence and operations officer (S2/S3), supply officer (S4), and the sergeant major.

Company headquarters provides command, administration, mess, communications, and supply for the company. Other company personnel man the battalion staff sections and a terrain team (used in GS of theater army). The unit structure is shown in figure 2-2.

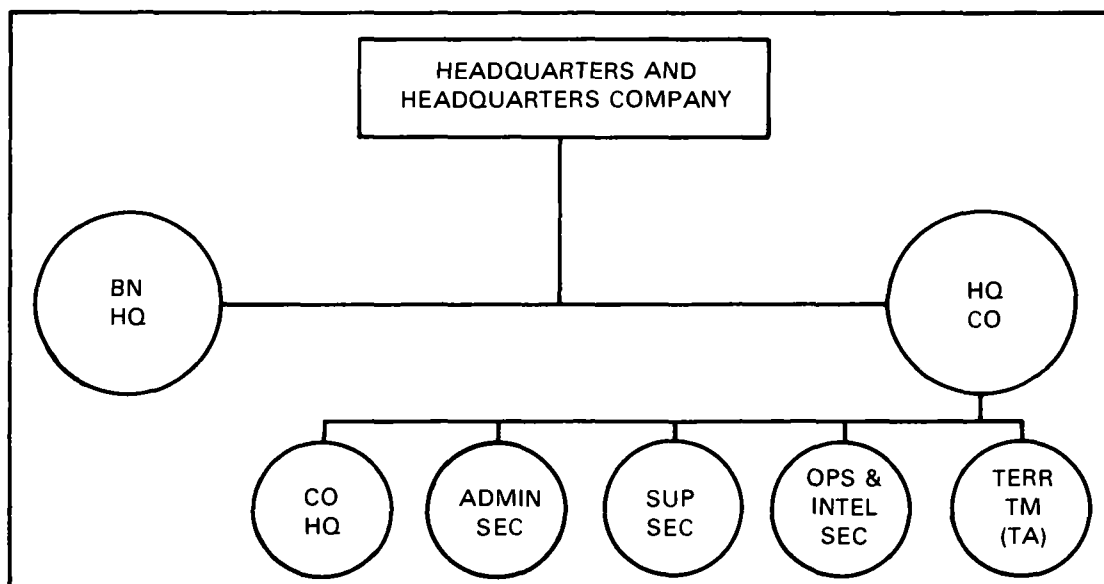


Figure 2-2. HHC, Engineer Topographic Battalion.

General Tasks

Primary contribution of headquarters and headquarters company to the battalion's capabilities is command, staff planning, and supervision of theater topographic units. In addition, it also can:

• Provide technical support to topographic units
• Compile graphic and textual topographic products from all sources of information
• Collect and coordinate field terrain information
• Analyze terrain information for military operations and prepare subsequent terrain intelligence products
• Provide topographic advice to tactical commanders

Specific Tasks

Battalion Command Section (CDR, XO, CSM)

The Engineer Topographic Battalion Commander has several responsibilities in addition to overseeing technical operations and troop welfare (maintenance, supply, administration, tactical operations).

He and his staff are the primary source of topographic information and advice for the theater army topographic staff. In some instances, he may perform the dual functions of topographic staff officer and battalion commander.

He is responsible for coordination and liaison with other members of the US and allied topographic communities concerning technical matters. Although a separate theater MC&G staff may exist, authority for direct coordination with outside agencies on technical matters is normally delegated to the battalion.

He helps develop and execute the battalion portion of the Theater Army Topographic Support Plan (TATSUP, see FM 21-32) and missions specified in the topographic annexes of OPLANS.

The battalion executive officer normally performs the functions of a chief of staff. He supervises and directs the staff officers and monitors special areas of interest at the commander's direction. His primary task is the integration of battalion administration and logistical functions with topographic operations.

The command sergeant major is the battalion commander's primary advisor concerning matters affecting enlisted personnel. He provides guidance and direction for the battalion's noncommissioned officers and establishes an informal noncommissioned officer chain of command for day-to-day housekeeping requirements. He also monitors special areas of interest at the commander's direction.

Administrative Section

The administrative section consists of the adjutant (S1), a personnel sergeant, a career counselor, a legal specialist, and several clerks. The normal battalion administrative tasks for the section include:

• Personnel actions
• Reports
• Postal and distribution operations
• Legal actions
• Personnel management
• Public affairs
• Correspondence management

Since the administration section is small, it is dependent upon the engineer brigade for many administrative functions. These functions include finance actions, personnel records maintenance, personnel management (procurement, actions), health services, civilian personnel management, religious services, special services, and legal services.

The adjutant coordinates required support with the engineer brigade personnel officer.

Operations - Intelligence Section

Operations and intelligence functions are combined in the largest of the battalion's three staff sections. This section provides staff operations common to all battalions plus specialized topographic staff functions. These functions are listed in table 2-1.

Table 2-1. Operations and Intelligence Section Functions.

GENERAL OPERATIONS	TOPOGRAPHIC OPERATIONS
● Security Program ● Intelligence Collection/Dissemination ● Classified Material Storage ● Communications—Electronics ● Tactical Plans ● Tactical Operations Orders ● Tactical Operations ● Unit Movement ● NBC Operations ● Training (General Subjects) ● Standard Operating Procedures	● Topographic Plans ● Technical Liaison/Coordination ● Production Management - Production Plans - Coordination - Project Assignments - Orders and Directives - Production Control - Edit ● Map Supply Management ● Technical Assistance/Advice ● Training (Topographic)

The technical expertise in the section is provided by photomapping and survey warrant and senior noncommissioned officers and a reproduction noncommissioned officer. In support are terrain analysts, map editors and other clerical assistants. The section is headed by the S2/S3 and his assistant, a terrain intelligence officer.

GENERAL OPERATIONS

The references in Appendix A (FM 21-32, specifically) detail staff responsibilities and functions for general operations.

TOPOGRAPHIC OPERATIONS

Topographic Plans. Long-range planning is necessary to insure fulfillment of in-theater topographic requirements identified in the TATSUP.

Topographic requirements prior to hostilities are oriented toward projects which contribute to data base information (e.g., cross-country movement maps, road and bridge maps). These projects involve the use of much of the battalion's terrain and cartographic capabilities and, therefore, demand long-range planning and mission tailoring. Plans are also required for contingency missions stated in the topographic annexes of the supported units' OPLANS.

The topographic annexes of OPLANS typically include provisions for the allocation of assets, augmentation, and support requirements including map issue and resupply. The battalion commander and the operations officer have an advisory role in the development of these plans.

Planning considerations and sample topographic plans are given in FM 21-32.

Technical Liaison/Coordination. Topographic production may require coordination with other agencies. For standard products, those which conform to prescribed specifications (e.g., a NATO Standard format), coordination may be necessary with CONUS-based or host nation topographic activities to resolve specification questions, to arrange for special supplies or materials, or in some instances, to arrange for product editing.

The operations and intelligence section is the focal point for these coordinating activities. Other liaison/coordination functions usually performed by the commander or jointly by the commander and S3 are: participation in theater MC&G meetings, attendance at DOD MC&G meetings, and liaison with host national topographic organizations for joint activities. When there is a topographic planning and control team (Chapter 3) in the

theater, the battalion's role in these activities normally is reduced.

PRODUCTION MANAGEMENT

The operations and intelligence section's primary topographic task is supervising the execution of its plans and orders. The general term for this function is production management.

Production Plans. Production plans are prepared for specific projects and for the battalion's assets as a whole.

Plans for the entire battalion are usually projected for a fiscal year on a quarterly basis. These plans are developed for the execution of the topographic requirements stated in the TATSUP. Factors considered in forming production plans are the workload, unit capabilities, source availability/quality, and available production time. Output is stated in general terms such as the numbers of the various categories of products expected to be produced.

Plans for specific projects are formed by analyzing requirements and specifications, available source materials, production capabilities, logistical requirements, and priorities of existing projects. Plans are published as operations orders or project directives and schedules.

Coordination. Coordination requirements consist of managing work flow among the general support topographic units and arranging support and assistance for the direct support teams and companies. The operations section also coordinates with supply and maintenance personnel to insure that assets and materials are available for production.

For nonstandard products, coordination with the requester is the most effective means of providing timely, appropriate support. Direct coordination is normally authorized by the battalion's higher headquarters. The operations section further authorizes direct coordination for technical matters to the production units.

Project Assignments. The operations section allocates battalion resources by estimating

production capacity and weighing requirements against capabilities. Although resource allocation is initially programmed in the planning phase, changes in requirements, priorities, and available assets make review of resources a continuing task.

When resources vs. requirements problems arise, the operations officer determines the best course of action. Normally, his choices for existing projects include:

• Increasing production time
• Decreasing nonproduction efforts (e.g., data base maintenance)
• Personnel or unit augmentation
• Equipment augmentation
• Revising priorities
• Coordinating to modify requirements
• Coordinating production with other topographic units

RESOURCES/REQUIREMENTS CAN CAUSE PROBLEMS

The commander's decision, based on the operations officer's recommendations, is published in the form of changes to operations orders and directives.

OPERATIONS OFFICER RECOMMENDS ACTION

Orders and Directives. Topographic unit instructions are passed to subordinate units either as standard operations orders or as project directives. For short range projects or modifications to existing projects, a work order is also used.

For all projects the operations officer determines:

Priority. A priority for the project is assigned within a priority list established for all concurrent projects.

Specifications. The specifications for the project are defined either by reference to a standard or by inclusion of detailed specifications as an annex to the directive.

Other tasks related to project instructions include maintaining detailed project files for all directives and related correspondence; and maintaining an operations and work order log.

Production Control. The operations officer manages production by establishing standard operating procedures for work flow; and by preparing project schedules and monitoring progress through technical visits and reports.

Schedules are established for each project and integrated into the operation section's master schedule.

**REPORTS ARE
MINIMIZED**

Reports used may vary widely. They range from daily telephonic reports for high priority, fast moving projects, to weekly, monthly, or quarterly production reports. The operations officer designs a reporting system which corresponds to the type workload and tactical situation. Reports are kept to the minimum required to maintain control.

**THE HISTORICAL FILE IS
FUNDAMENTAL TO FUTURE
PLANNING**

Usually an after-action report is filed for each project. This historical file is used to accumulate production statistics for future planning. Also, at the end of a project, the operations section files final and interim project materials.

Edit. Another production control technique the operations officer uses is to perform interim edits. For example, the operations section editors may edit final cartographic work before it is approved for reproduction. Normally the operations officer determines specific edit plans which fit the battalion mission.

The operations section has nine assigned editors who are supervised by warrant officers and senior noncommissioned officers. They provide final edits of all battalion products as well as those interim edits directed by the operations officer. Edit procedures are detailed in TM 5-240.

MAP SUPPLY MANAGEMENT

The operations officer monitors the cartographic companies operating the corps and theater map depots and the topographic map inventory control point (TMICP). He also provides assistance to the theater and corps G2s for the preparation of reserve stockage and distribution plans.

The operations section coordinates distribution within the theater to all service components, and plans/coordinates transportation requirements. It monitors map supply responsiveness through visits, reports, and follow-up contact with requesters. Map supply operations are detailed in the discussion of the cartographic company.

TECHNICAL ASSISTANCE/ADVICE

The operations section normally has some of the most experienced technicians in

the battalion. One of their tasks is to make their knowledge available to units throughout the battalion. They review projects in progress and answer questions concerning specifications and techniques. The warrant officers act as a liaison between unit operations officers and the battalion operations officer.

By keeping in touch with the projects as they progress, the operations section avoids mistakes and delays which prevent timely support to the requesters.

TOPOGRAPHIC TRAINING

The operations and intelligence officer is responsible for directing and coordinating training in the battalion. Normally, primary responsibility for this task within the section falls on his assistant, the terrain intelligence officer. Training for topographic units is discussed in Chapter 4.

Supply Section

The supply officer (S4) is assisted by a warrant officer technician, a senior noncommissioned officer, and several clerks. The tasks performed by this staff are shown in table 2-2.

Table 2-2. Supply Section Functions.

• Logistics Planning	• Supply & Equipment Evacuation
• Records Maintenance	• Procurement
• Facilities/Utilities Utilization	• Storage
• Liaison	• Issue
• Logistics Readiness	• Supply Training
• Reports	

In addition to these specific tasks, the S4 assists the commander by providing staff supervision of :

	<i>maintenance</i>
	<i>maintenance training</i>
	<i>food service</i>
	<i>fire protection</i>
	<i>damage control</i>

The references in Appendix A describe the performance of these staff responsibilities. The supply actions, which are unique to the engineer topographic battalion, are discussed below.

SUPPLY PROCUREMENT AND MAINTENANCE

The low density of topographic equipment and supplies in the theater area is a potential problem for the supply officer. Supplies used at a relatively slow rate in peacetime may not be readily available when hostilities begin; the type products produced in peacetime differ significantly from the quick-response products provided to the commander in war; and supply needs can change quickly. Repair parts and replacement equipment may not be readily available due to low demand experience during peacetime. To overcome these problems, the topographic engineer battalion supply officer takes several actions:

TOPOGRAPHIC SUPPLIES ARE UNIQUE

- | |
|--|
| • Establishes a local purchase program for critical topographic supplies. |
| • Obtains exceptions, when necessary, to prescribed load list (PLL) (demand experience stockage criteria) for critical repair parts. |
| • Maintains a 30-60 day reserve stockage of topographic supplies. |
| • Establishes close working relationships with maintenance units. |
| • Maintains liaison with the supply personnel of other agencies in the topographic community. |

STORAGE

Many topographic supplies have specified shelf lives. The supply officer must maintain an active program of stock rotation for both daily supplies and reserve stocks.

REGULAR STOCK ROTATION IS ESSENTIAL

SUPPLY TRAINING

Since most topographic supplies are unique, personnel trained for general supply operations often have difficulty identifying stock and determining suitable substitute items. The supply officer, with the support of the technicians from the operations section,

is responsible for training his personnel in topographic supply.

Similarly, supporting supply depot personnel are usually unfamiliar with topographic supplies. Therefore, close coordination between battalion supply personnel and depot personnel is necessary. When requested, the supply officer should provide technical assistance to the supporting depot.

Terrain Team, Theater Army

The theater army terrain team is identical to the corps terrain team described in detail in Chapter 3. Unlike the corps direct support team, it is organic to the battalion and is used in general support to fulfill terrain requirements from theater army headquarters and its supporting units.

In addition to its normal terrain team operations, the theater army team coordinates battalion efforts to collect data on natural and cultural terrain features. It is the primary repository for terrain information in the theater area. The tasks related to this role are:

- | |
|--|
| • Supporting corps terrain teams with information |
| • Coordinating collection activities among corps terrain teams |
| • Providing liaison with the terrain analysis activities of other topographic agencies |

The team has a headquarters and three sections which operate from the Topographic Support System (TSS) MGI modules.

COLLECTION SECTION

Collects data from all sources including field reconnaissance. The collection module is equipped to obtain weather, soil and hydrologic data; catalogue it; and pass it on to the analysis section for further processing.

INTERPRETATION AND ANALYSIS SECTION

Operates the analysis module and the synthesis module. Both modules contain photo interpretation equipment; and the

analysis module can reproduce small quantities of overlays. The analysis module also contains an Analytical Photogrammetric Positioning System (APPS).

The analysis phase consists of evaluating and analyzing data provided by the collection section and preparing it for inclusion in the data base. The synthesis phase consists of extracting information from the data base, supplementing it with more recent information from the collection section, and putting together a product or reply to meet a commander's needs.

INFORMATION SECTION

Stores the MGI data base. The information module contains the equipment necessary to store, retrieve, and display information. It also has equipment to reproduce a small quantity of overlays or other graphics.

The structure, equipment, and tasks of terrain teams are discussed in detail in Chapter 3.

Company Headquarters

The company headquarters provides command and control, administrative, and housekeeping support for battalion headquarters. It also provides organizational maintenance and dining facilities for the survey company.

The company headquarters consists of the commander, first sergeant, and thirty-three others with skills in mess, communications, maintenance, and supply.

The communications sergeant operates the battalion communications center under the supervision of the S3. The food service sergeant operates the battalion dining facilities and assists the S4 in monitoring other dining operations in the battalion. Similarly, the battalion motor sergeant operates the battalion motor pool and assists the S4 with maintenance inspections and advice.

The maintenance capabilities of headquarters company include organizational maintenance for ordnance, power

generating, and communications—electronic equipment.

When operations permit, the battalion consolidates mess and maintenance operations for its units in the COMMZ. In this case, the headquarters company noncommissioned officers supervise the consolidated operations.

TASKS

The headquarters company commander is responsible for the routine administrative, training, logistical, and support functions common to headquarters units. The theater army terrain team is a part of headquarters company. The company commander does not oversee its operations but does provide administrative and logistical support.

SPECIAL CONSIDERATIONS

The specialized functions, personnel, and equipment of the topographic battalion require special considerations in its deployment.

- *Mobility*— headquarters and headquarters company, except the terrain team, is one-hundred percent mobile with organic equipment. The movement of the terrain team modules requires truck tractors obtained from general support transportation units in the theater. All of the company's equipment is air transportable.
- *Tactical Operations*— topographic units are armed with individual weapons only and are not capable of independent defense of an area. The headquarters company normally contributes to the defense of the rear area by providing guards to the area commander and participating in the rear area defense plan. Topographic troops are used for combat only in emergency defense operations and are returned to normal operations as soon as possible.
- *Communications*— the transfer of data by telecommunications is essential to the terrain team operations. The terrain team information section's facsimile transmitter/receiver is linked to those of the terrain team

HEADQUARTERS OVERSEES ALL MISSIONS

COMMUNICATIONS ARE VITAL

corps G2 and/or MI units for rapid transfer of information. Therefore, access to communications nets is a prime consideration in deploying the terrain team. Other communications within battalion and headquarters company are limited to battalion AM and FM nets and land lines.

SURVEY COMPANY

Survey Missions

The accuracy of modern artillery and missile systems depends, to a great extent, on the accuracy of the position, elevation, and azimuth data for the firing location. The speed with which artillery and missile units engage the enemy may determine the outcome of the battle. The survey information provided to the artillery surveyor must be timely, accurate, and in the correct format if weapon systems are to be responsive and effective. This rapid determination of survey data is a primary function of the survey company.

Information on existing survey control is vital to the conduct of survey support of weapon systems. A survey information center (SIC) collects, correlates, and disseminates information on existing third order or higher survey control, within the theater of operations.

The survey company also establishes control for mapping/map revision products; orientation and extension of photogrammetric data bases; support of theater military construction activities; and position/azimuth data for various other organizations within the theater of operations (i.e., communications, terrain information, position/navigation systems, etc.).

Organization

The survey company is designed and equipped to provide survey support to a theater army conducting operations with three corps. To provide this support, the company has been organized into a company headquarters, operations section, and three

PRIMARY MISSION OF THE SURVEY COMPANY IS TO PROVIDE POSITION AND AZIMUTH IN SUPPORT OF DEPLOYED WEAPON SYSTEMS THROUGHOUT THE THEATER OF OPERATION

COMPANY SURVEY INFORMATION CENTER PROVIDES A SINGLE ACCESS POINT FOR THEATER SURVEY DATA

FLEXIBILITY OF ORGANIZATIONAL STRUCTURE PROVIDES RESPONSIVE SUPPORT TO ALL ECHELONS WITHIN THEATER

NECESSARY AUGMENTATION IS PROVIDED

survey platoons (fig. 2-3). In the three-corps concept, the survey platoons are deployed in each corps area and provide direct support to artillery and missile unit requesters. The platoons also may operate with the company providing GS or DS within the COMMZ depending upon specific requirements.

In the event a fourth corps is involved in combat operations, the company will be augmented with a fourth survey platoon. Additional survey support will be provided by the attachment of one or more of the specialized survey teams described in Chapter 3, if mission requirements exceed the capabilities of the augmented company.

Operations and Capabilities

Survey Company Headquarters

The company headquarters section provides the administrative and logistics support necessary for survey operations. This section is staffed by the commanding officer, first sergeant, supply sergeant, and six enlisted clerical and supply personnel to support administrative and supply activities. The headquarters supply section maintains specialized survey equipment for use by the survey platoons when executing specialized tasks such as establishing astronomic position, azimuth, and precise baselines. The headquarters section does not provide the maintenance or messing activities required to support company operations. These are provided by headquarters company or by a designated supported unit if the survey platoons are separated from the company due to operational requirements.

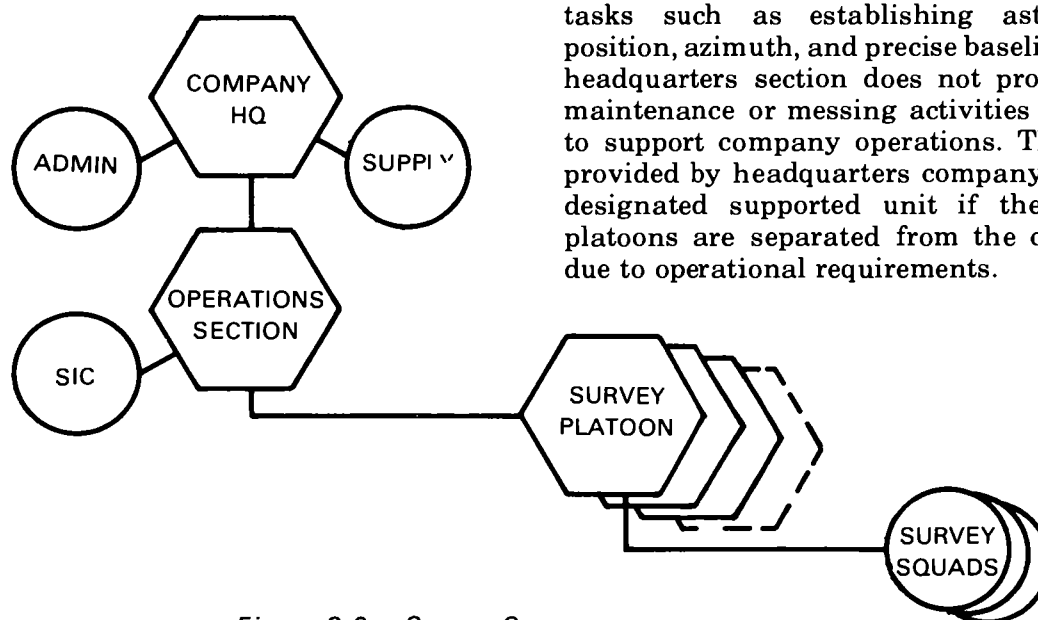


Figure 2-3. Survey Company.

Operations Section

The company operations section is the technical heart of the unit. It consists of the operations officer, a survey technician, and clerical and survey enlisted personnel. The section provides the commander with the assets to insure all mission requirements are met. This section is supervised by the operations officer, who is also the company executive officer.

The operations section is assigned additional survey, drafting, and clerical personnel to check computations on completed projects; draft and prepare project data for distribution; and operate the survey information center.

Survey requirements are normally received by the operations section which evaluates them and assigns a priority. Source/planning data is collected, attached, and forwarded to a platoon for execution. During combat operations, where one or more of the platoons is separated from the company, requests for survey support may go directly to the platoon headquarters. In such cases, the operations section is informed and monitors the operations, providing support as necessary. Upon completion of a project, the operations section checks all field records and computations to insure the work meets specifications. A project report with accompanying data is then prepared for distribution to the requesting unit. The operations section prepares and maintains progress reports on all assigned projects for the unit commander and higher headquarters. Survey systems and methods are summarized in table 2-3.

A survey information center (SIC) is maintained to provide units with the coordinates, elevation, azimuth, and description of survey control points within the theater of operations. This center also collects, evaluates, stores, and distributes information on survey control points established during operations. The operations officer and survey technician maintain a close relationship with artillery

TECHNICAL GUIDANCE AND PLANNING IS THE RESPONSIBILITY OF THE WARRANT OFFICER SURVEY TECHNICIAN AND THE SURVEY NON-COMMISSIONED SUPERVISOR

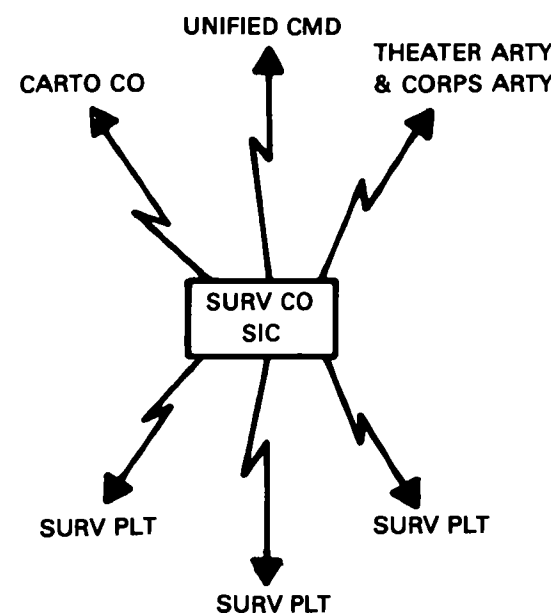


Table 2-3. Survey Systems and Methods.

APPS (Analytical Photogrammetric Positioning System)

Positioning accurate to within 10 to 40 meters in position and 10 to 20 meters in elevation.

Accuracies are dependent upon the scale of the data base and the ability of the operator to identify the point on the data base.

Limited by the availability of the data base.

INERTIAL SURVEY SYSTEM

Vehicle mounted survey system capable of surveying approximately 40 km/hr. System may be mounted in an aircraft.

Provides position and elevation accurate to within one meter and azimuth to within 20 seconds of arc relative to the accuracy of the initial and final survey control points.

Limited by the availability and location of the initial and final survey control points.

DOPPLER (Satellite Tracking System)

Position and elevation accurate within 3 to 30 meters dependent upon the number of satellite passes tracked.

Position and elevation available within a 2 to 24 hour period dependent upon the accuracy required.

System limited by the availability of satellites.

TRAVERSE

Conventional survey method providing relative accuracies of 1:5,000 to 1:100,000 between directly connected previously established survey control points.

Provides an azimuth accurate within 1 to 8 seconds of arc per traverse station occupied.

Limited by availability of existing survey control and weather conditions affecting visibility.

Average survey progress of 24 to 60 km per day dependent upon terrain conditions.

TRIANGULATION/TRILATERATION

Conventional survey method providing relative accuracies of 1:5,000 to 1:100,000 between directly connected previously established survey control points.

Provides an azimuth accurate within 1 to 8 seconds of arc per triangulation station occupied.

Limited by availability of existing survey control and weather conditions affecting visibility.

Average survey progress 18 to 24 km per day dependent upon terrain conditions.

ASTRONOMIC OBSERVATIONS

Position accurate within 4 to 15 meters dependent upon the number of stars observed.

Azimuth accurate within 0.5 to 8 seconds of arc dependent upon the number of stars observed.

Limited by weather conditions affecting visibility.

Azimuth available within 1 to 6 hours and position within 24 to 48 hours dependent upon accuracies required.

GYROSCOPIC AZIMUTH (Desired)

An all weather azimuth capability providing an azimuth accurate within 30 seconds of arc one-half hour after instrument set-up.

TRIGONOMETRIC LEVELS

Provides elevation accurate within 2 meters.

Usually used in conjunction with traverse and triangulation.

Limited by the same factors as traverse and triangulation.

DIFFERENTIAL LEVELING

Provides elevation accurate within 0.04 to 0.06 meters.

Limited by the availability of existing vertical control within the project area and weather conditions affecting visibility.

Average survey progress of 7 to 10 km per day dependent upon terrain.

**FIELD ARTILLERY POINTS-OF-CONTACT
PROVIDE CURRENT DATA**

**THE SURVEY PLATOON LEADER
MAINTAINS A CLOSE RELATIONSHIP
WITH COMPANY OPERATIONS AND/OR
THE SUPPORTED ORGANIZATION TO
INSURE THAT ALL MISSION REQUIRE-
MENTS ARE UNDERSTOOD AND
ACCOMPLISHED**

and other survey organizations to insure a two-way flow of information concerning operations and data collection.

Field artillery survey point-of-contact at corps tactical operations center (CTOC) is the target acquisition staff officer of the field artillery section (FAS). At division artillery, the division artillery survey officer is the survey point-of-contact. He may be located in the division artillery (DA) survey information center (SIC) co-located with the DA TOC.

Survey Platoon

The three survey platoons (and fourth if augmented) assigned to the company are designed and equipped to operate as independent corps support units. Each platoon (approximately 40 people) consists of a platoon headquarters and three field survey squads.

Each platoon is capable of providing final adjusted positions, elevations, and azimuths using various methods. These methods include establishment of survey control by traverse, triangulation, trilateration, astronomic observation, differential and trigonometric leveling. Positions may also be determined by using the Analytical Photogrammetric Positioning System (APPS), Dopler (satellite) System, the Inertial Survey System (when adopted). All-weather azimuth capability is provided by north seeking gyroscopic instruments. The platoons operate from a survey module and a maintenance module.

The survey platoon is directed by the platoon leader aided by a survey technician and a noncommissioned survey supervisor. During GS operations, the survey platoon receives survey missions from the company operations section. If the platoon is in direct support of corps, the survey mission might be received from the supported organization.

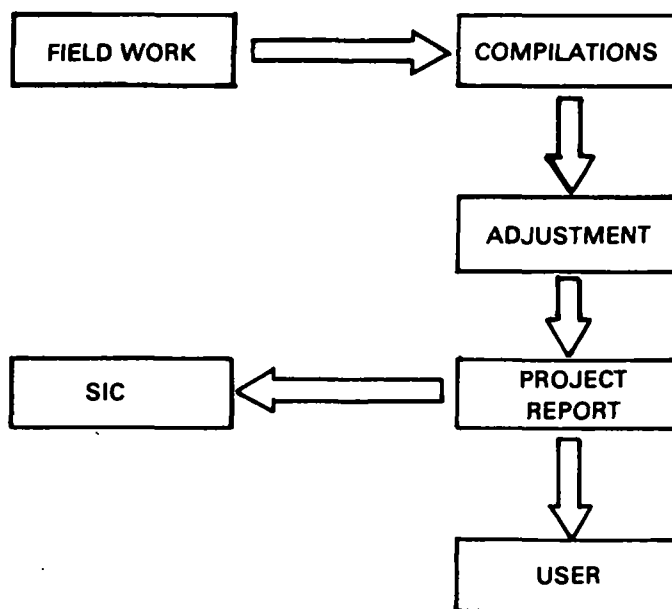
Upon receipt of a survey mission by a platoon, the survey technician and the survey noncommissioned officer evaluate the requirement and perform a preliminary

reconnaissance to determine the control available and the survey method to be used. The mission is then assigned to one or more of the survey squads for execution. The survey technician and NCO monitor the progress of the squads to insure that all methods and procedures meet the requirement of the mission.

Survey Squad

Each of the three survey squads within the survey platoon are capable of performing traverse, triangulation, trilateration, astronomic azimuth, and leveling operations. These squads perform all field measurements and preliminary computations (to check results against specification). When operating as a direct support unit, computations, adjustments, and project reports are prepared within the platoon and provided to the supported unit with a copy forwarded to the SIC. With the equipment available to the survey platoons, positions, azimuth and elevations are available quickly to any unit within the theater of operations.

THE USER SHOULD CLEARLY DEFINE HIS NEEDS. THE RESULT—EFFECTIVE AND RESPONSIVE EMPLOYMENT OF THE AVAILABLE SURVEY RESOURCE



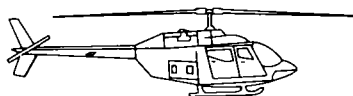
SURVEY DATA FLOW CHART

Special Considerations

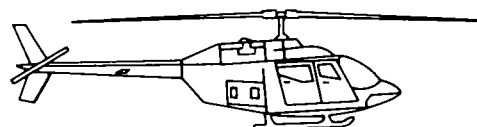
Many requests for survey support are forwarded without the requirements being clearly stated. Some requests are incomplete or contain unrealistic technical requirements. These hinder survey operations by expending time, which could have been used in survey operations, to define the actual requirement. Requests for survey support should be clearly stated and contain:

- **Location requirement**— Where is the survey control to be located?
- **Position requirement**— How accurate must the position be? This information helps in determining the type and method of survey.
- **Elevation requirement**— How accurate must the elevation be? This information helps in determining the method of establishing vertical control.
- **Azimuth requirement**— Is an azimuth required? If so, how accurate must it be? This information helps in determining the method of azimuth determination.
- **Time factor**— What is the latest acceptable product delivery data and what is the desired date?
- **Intelligence estimate of work area**— What enemy activity, friendly forces, barriers, minefields, and other operational constraints exist?

Survey platoons in extended direct support operations must be attached to the supported unit for administration and logistics.



QUICK RESPONSE SURVEY SUPPORT OR RUGGED TERRAIN REQUIRES AVIATION



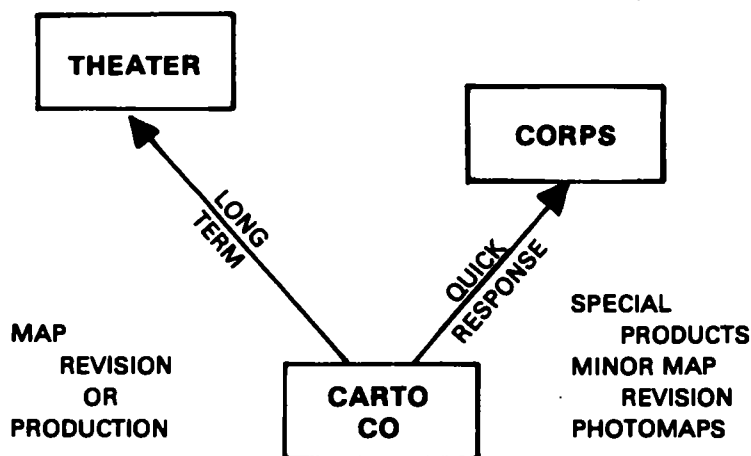
The survey company does not have an aviation section. Aviation support may be required for survey reconnaissance or to move surveyors and their equipment. On some projects, a dedicated aircraft is required to provide a platform for the inertial survey system. This support should be coordinated by the requester, company operations officer, and survey platoon leader. In some cases, aviation support will be vital to mission accomplishment, particularly where combat operations limit the time available to complete the survey.

CARTOGRAPHIC COMPANY

The cartographic company was established to keep pace with the demands of tactical commanders for topographic products that depict the changing developments on the modern battlefield. The key is rapid response, giving field commanders updates to existing maps, map substitutes (controlled and semicontrolled photo-based products), combat-orientated terrain intelligence overlays, and terrain studies. The cartographic company also reproduces, stores, and distributes maps and map-related products.

**RAPID RESPONSE IS THE KEY!
GIVE COMMANDERS THE PRODUCTS
THEY REQUIRE—
WHEN THEY NEED THEM**

The company is designed to provide general support to a theater army or direct support to a corps. When supporting a theater, the company generally works on map revision and long-term, map-related products. In a corps area, the company is responsive to support requests channeled through the corps engineer or G2. It is normally attached to the engineer brigade for administration and logistics (minus topographic supplies). At this level, the cartographic company works primarily on the final compilation and color separation for terrain studies, special maps, map revisions, and photomaps. Generally, the company must work closely with the direct support terrain team to provide quick response products (overlays, overprints, or photo-based products.).



Organization

The cartographic company (fig. 2-4) consists of a company headquarters section, a photomapping platoon, a reproduction platoon, and a storage and distribution platoon.

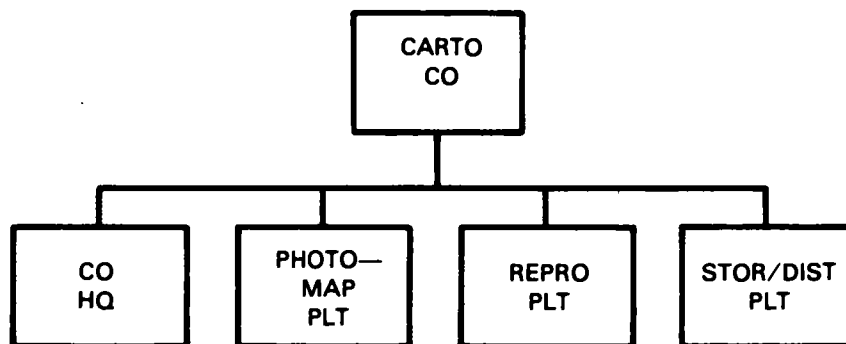


Figure 2-4. Cartographic Company.

Operations and Capabilities

Unless augmented, the company is staffed for single shift operations. It is housed in mobile modules. The nature of the cartographic company requires that its modules be in close proximity to one another during operations; however, its assets can be tailored to support separate operations. The modules are equipped with heaters and air conditioners to provide the required environmental control for the materials and equipment used in the production of maps and related products.

Company Headquarters

The company headquarters section provides the command element for the company. It is staffed by a company commander, topographic production officer, first sergeant, topographic sergeant, and necessary personnel to provide messing, administration, and supply. Maintenance capabilities include organizational maintenance for ordnance, power generating, and reproduction equipment.

COMMAND AND CONTROL MODULE IS THE CENTER OF OPERATIONS

The focal point for company operations is the command and control module. It is here where the topographic production officer (who also is the company executive officer) supervises the topographic operations, by

utilizing production charts, schedules, and technical guidance provided by the photomapping and map reproduction technicians. The photomapping and reproduction platoons may also provide enlisted personnel for the quality control of the company's products.

QUALITY CONTROL CAN COME FROM PLATOONS

Photomapping Platoon

The photomapping platoon consists of a platoon leader, photomapping technician, and approximately 60 enlisted personnel. One of its tasks is constructing controlled, semicontrolled, and uncontrolled mosaics using aerial photography. These mosaics are then overprinted with a grid, feature labels, marginal data, and other pertinent information, thus producing an up-to-date map substitute (photomap) to aid the commander.

Another task is making expedient revisions to existing maps and map substitutes, as well as quick updates of large scale maps. The time to produce a product depends upon available source material (such as aerial photography); control required; equipment capabilities; and extent of the required revision.

The photomapping platoon also drafts special maps, overlays, terrain study overprints of existing maps, and other topographic products. The organization of the platoon is shown in figure 2-5.

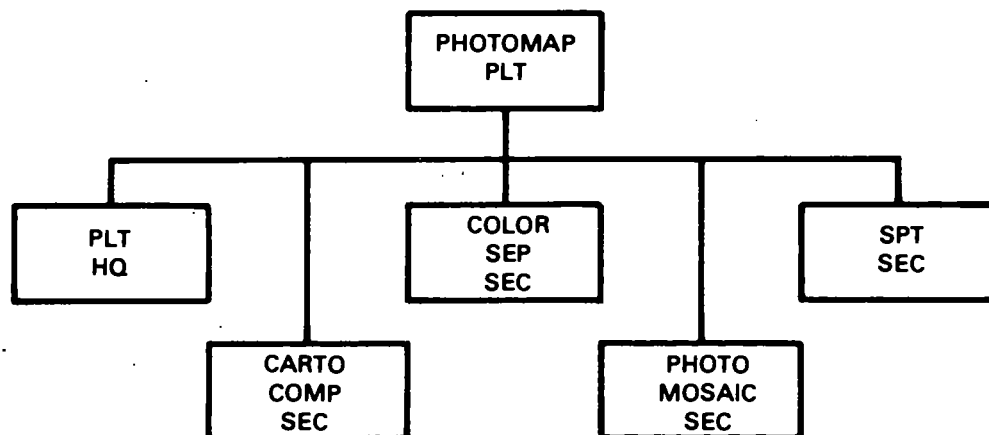


Figure 2-5. Photomapping Platoon.

PLATOON HEADQUARTERS

The platoon headquarters contains a platoon leader, a photomapping technician, a platoon sergeant, and a senior cartographic specialist. Together, they provide command, organization, and operational control.

The platoon leader's duties consist primarily of command and coordination of the platoon's activities. Technical operations are supervised by the photomapping technician who is assisted by the platoon sergeant/cartographic control sergeant in the planning, scheduling, and overall production control.

SUPPORT SECTION

The support section is housed in five modules: 1 storage and retrieval; 1 distribution; and 3 mosaicking/drafting. This section provides type support, via a photocomposing machine, for final printing of feature labels and marginal data on the map products. It also provides monochrome reproduction of overlays and other hasty products (by means of a Diazo process printing and developing machine); computational support for grids and projections; and supplementary control, using the analytical photogrammetric positioning system (APPS).

The support section is responsible for the storage and distribution of supplies within the photomapping platoon.

CARTOGRAPHIC COMPILATION SECTION

This section performs compilation (delineation of cultural, drainage, and relief features) for map revision, special maps, overprints, overlays, and other topographic products. It uses stereoscopic transfer devices, a split stage imagery viewing table, and a reflecting projector. An analytical stereoplotter, if included in the final TSS concept, will be used to produce digital data for input to the off-line orthophoto printer in the photomosaic and rectification section for orthophoto production. This section is housed in two compilation modules.

COLOR SEPARATION SECTION

This section consists of approximately 18 enlisted personnel, and works from the drafting support module. Negative engraving or ink drafting by these cartographic specialists separates the colors of the compilation manuscript into separate sheets in preparation for lithographic offset printing. Negative engraving is accomplished manually in three cartographic modules using light tables, scribecoat, peelcoat, rigid and swivel scribes, rapidograph pens, and swivel-stencil knives.

Color separation also may be accomplished using the semiautomated interactive graphic system, when provided.

PHOTOMOSAIC AND RECTIFICATION SECTION

Manned by an NCO and cartographic enlisted personnel, the photomosaic and rectification section prepares controlled and uncontrolled mosaics. It also performs rectification of aerial photography (removal of distortions caused by a wing-up or nose-up position of the aircraft in which the camera is mounted) and produces orthophotographs using an off-line orthophoto printer.

The section is housed in four rectification modules and two mosaicking/drafting modules.

Reproduction Platoon

The reproduction platoon is equipped with ten mobile modules which house the reproduction equipment and provide limited working space. Each module is equipped with a heater and air conditioner which provide the environmental control necessary to maintain the dimensional stability of film, plastic sheet, and paper used in precise registration map reproduction. The platoon consists of a headquarters section, a photographic section, a layout/plate section, and a press section (fig. 2-6). The platoon conducts single shift operations unless augmented.

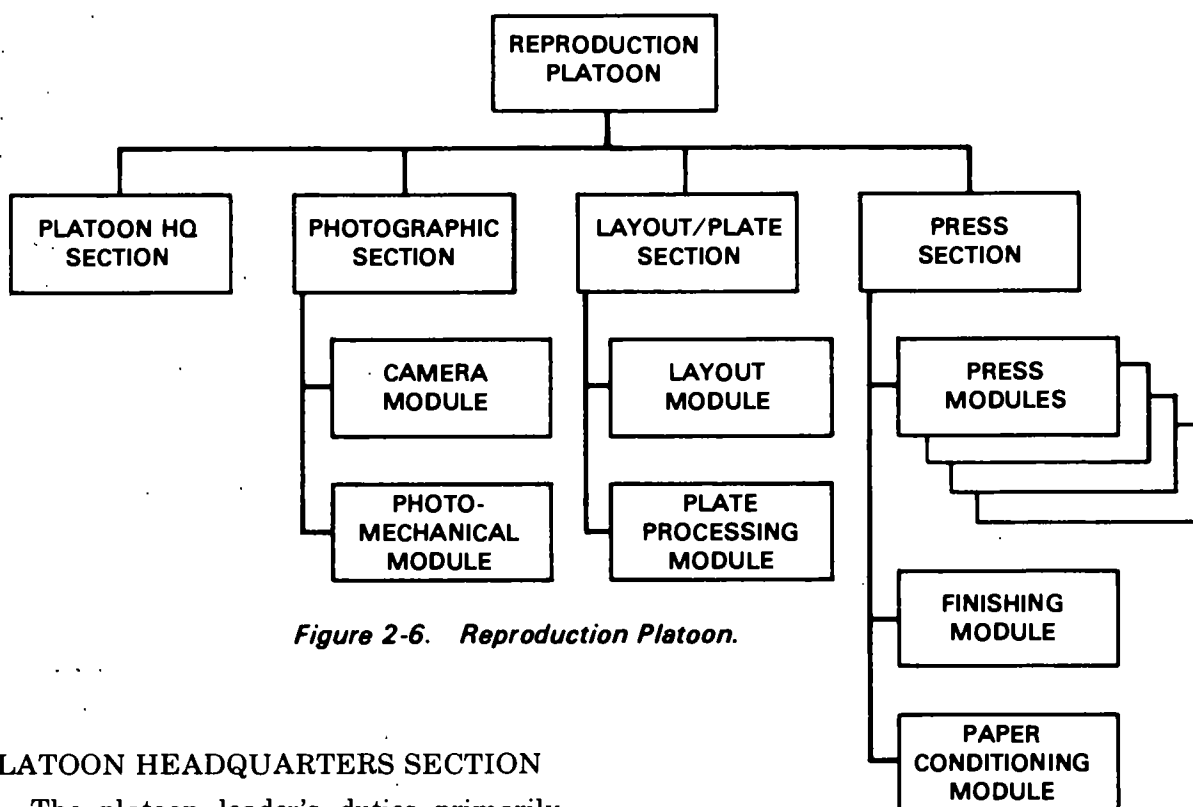


Figure 2-6. Reproduction Platoon.

PLATOON HEADQUARTERS SECTION

The platoon leader's duties primarily consist of command and coordination of the platoon's activities. Technical operations are supervised by a map reproduction technician who is assisted by a photolithography supervisor in planning, scheduling, and editing.

PHOTOGRAPHIC SECTION

The photographic section consists of photo/layout specialists controlled by the photolithography supervisor located in the platoon headquarters. The camera module is equipped to provide accurately scaled, undistorted line, halftone, and continuous tone film negatives and positives used in map reproduction.

The photomechanical module is a multipurpose vehicle equipped to provide a variety of products, to include duplicate film negatives or positives or reproducible material, color proofs and, in support of the photomapping platoon, processed scribing material and peelcoats.

**PHOTOMECHANICAL MODULE
IS VERSATILE**

LAYOUT/PLATE SECTION

The layout module is equipped to provide for the engraving (retouching), opaquing, layout, and registration of reproducible materials.

The primary function of the plate section is to provide lithographic printing plates in support of the press section. A secondary function is to process color proofs and support materials for the photomapping platoon. The section is manned by photo/layout specialists and is equipped with the plate processing module.

PRESS SECTION

The press section consists of four modules, staffed by offset press operators and equipped with a single color high speed press capable of providing line maps, photomaps, overlays, overprints, and combat-oriented terrain studies.

The section also has a finishing module operated by a bindery specialist. The module is equipped to provide a bindery capability and two shredder-balers for the destruction of classified waste and obsolete maps.

The paper conditioning module is used to acclimatize paper to the operating temperature of the press modules prior to printing.

SPECIAL CONSIDERATIONS

Planning Reproduction Support. When planning for reproduction support, requesters must consider that:

- Map sizes are limited to the size of organic presses and copy cameras, normally a maximum of 61 x 76 cm (24 x 30 inches for camera work).
- Operational necessity of a product will dictate the number of printed colors, not its esthetic value.
- Additional colors increase reproduction time.

Augmentation. Augmentation increases the capability of the cartographic company by providing additional personnel for a two shift operation of the reproduction platoon. However, augmentation personnel may not be readily available. Augmentation should be planned well in advance of the demand for increased production.

Storage & Distribution Platoon

The storage and distribution platoon receives, stores, issues, and distributes maps and related products. The platoon consists of a platoon leader and approximately thirty enlisted supply, warehouse, and packing specialists; and provides equipment for map depot operations. It operates the distribution module and stores map products. The theater army and corps level platoons have identical organization and equipment but the scope of their missions vary.

The platoon, in the theater army cartographic company, provides general support to theater army units and backup support to the corps mobile map storage and distribution subsystems. It operates the theater topographic map inventory control point (TTMICP) and the theater map depot. It provides daily data transmissions between the corps mobile map storage and distribution subsystem and between the TTMICP and the Defense Mapping Agency. These transmissions are made over corps and theater logistical communications channels.

The theater army platoon also packages products for distribution to theater units and for resupply of the corps mobile map storage and distribution subsystem.

The platoons of the corps cartographic companies operate the corps mobile map storage and distribution subsystems with limited stocks of maps for distribution to corps units and the division support commands (DISCOM). However, they do not maintain the large quantity of maps found in a fixed map depot. Map stockage levels for

theater and corps are determined by the G2 and can be computed from table 6-43, FM 101-10-1, Staff Officers' Field Manual,

Organizational, Technical and Logistical Data (Unclassified). The map distribution system is shown in figure 2-7.

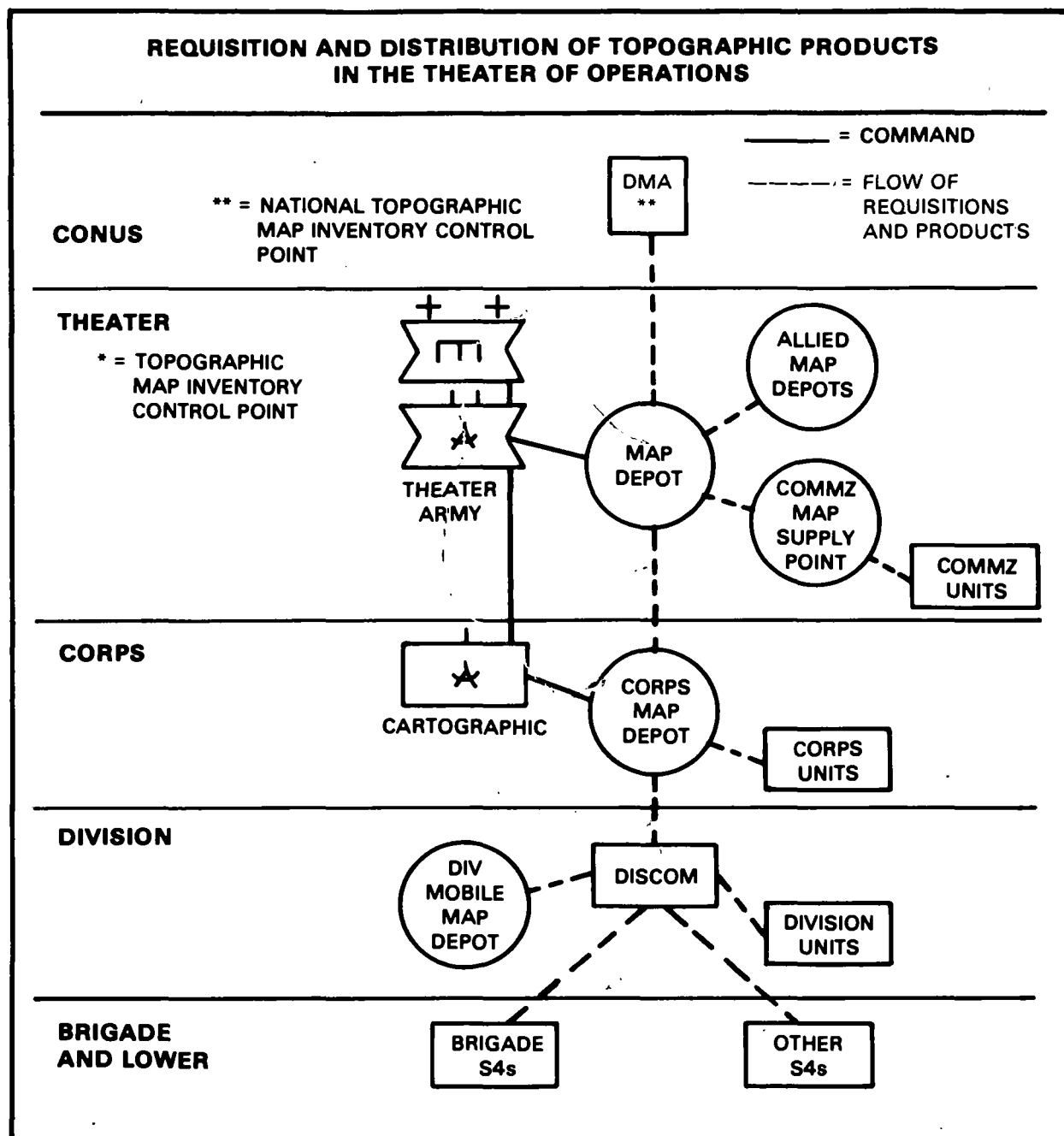


Figure 2-7. Map Distribution System.

Special Considerations

The specialized functions, personnel, and equipment of the cartographic company require special consideration in deployment.

- **Mobility**— The cartographic company does not possess the prime movers required for a simultaneous movement and will require truck tractors from units within theater army or corps. However, the entire company can be moved in three phases by using company assets.
- **Air transportability**— General purpose vehicles and cargo vehicles are air transportable by C-130 and C-141 aircraft. However, the modules which house photomapping and reproduction equipment are classified as overweight and outsized and require C-5 aircraft.
- **Tactical operations**— Cartographic company personnel are armed with individual weapons only and are not capable of independent defense of an area.
- **Movement**— The cross-country capability of the modules and transporters is extremely limited. The modules are relocated by using hard surface all-weather roads whenever possible.
- **Choice of operation area**— The site must be fairly level, well drained, and provide adequate overhead concealment.

An ideal location would be an industrial or commercial area with covered loading or service bays. A good

alternate choice is a large farm with barns and outbuildings.

If operational requirements dictate, a large, wooded area would be adequate, provided that local vegetation does not impede movement of tractor/transporters.

Dispersion of technical vehicles is restricted by operational requirements and by the 30-meter (100 feet) length of electric power transmission cable available for unit generators.

- **Water**— An adequate supply of suitable water is an operational necessity for photomapping and map reproduction. The cartographic company must be provided with water that is suitable for photolithographic map reproduction. To transport water for short distances, the unit is authorized two 1 1/2-ton (1512 liters or 400 gal) water tank trailers and a 2 1/2-ton (3780 liters or 1000 gal) water tank truck.
- **Electric power**— Power is normally provided by four 100KW generators. The loss of any of the authorized generators will impede operations and may render the unit incapable of accomplishing its mission. Local commercial electric power should be used if available.
- **Map depot**— The fixed map depots of the theater army cartographic company are highly dependent on logistics (particularly transportation and real estate) provided by general support theater army units.

CHAPTER 3

Topographic Teams

GENERAL

Topographic teams are organized as appropriate to provide specialized personnel and equipment for specific missions or for unit augmentation. TOE 5-540 teams are summarized in table 3-1.

The corps and division terrain teams are allocated on a basis of one per corps or division. The other teams are activated for special missions or augmentations as a result of:

- **Shortfalls identified in the theater army topographic support plan (TATSUP).**
- **Implementation of an OPLAN requiring specialized support.**
- **Increased demands upon theater topographic assets.**
- **Specialized requirements (long or short-term).**

The teams required are normally attached to the units they support for administration, logistics, and medical and religious services. They normally receive topographic supply and maintenance support from the theater army topographic battalion.

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Table 3-1, Topographic Teams.

TOE 5-540	
IA Topographic Planning/Control Team IB Geodetic Survey Team IC Survey Team IF Photomapping Platoon IG Map Reproduction Platoon	IH Map Distribution Platoon IJ Terrain Team (Corps) IK Terrain Team (Division) IL Survey Platoon

TOE 5-540 TOPOGRAPHIC TEAMS

Topographic Planning and Control Team (TOE 5-540-IA)

Used to supplement the staff capabilities at theater army, the planning and control team is headed by a lieutenant colonel who is assisted by officer specialists in terrain intelligence, mapping, and operations officer positions. The team's technical expertise is augmented by photomapping, reproduction, and survey warrant and noncommissioned officers. The remainder of the team consists of administrative and clerical personnel.

The team, allocated on a basis of one per theater army, is supervised by the ENCOM ACSI or, if there is none, the theater army engineer. As the command's topographic staff, it supervises topographic activities within the theater and provides coordination with the topographic community outside the theater. Specific tasks for the team fall into two categories, staff and supervisory functions.

Staff Functions

- Liaison with higher headquarters, the topographic community, and allied armies/organizations
- Coordination of mapping agreement activities with non-US mapping agencies
- Technical assistance to the theater topographic battalion
- Assistance in development of the TATSUP
- Advice to the theater staff in topography

Supervisory Functions

- MGI programs
- Survey activities
- Map reproduction
- Topographic support to commanders
- Map supply program

Through the ENCOM ACSI or the theater army engineer, the planning and control team provides operational control for the theater topographic battalion. It is normally located with the ENCOM or theater army staff.

The team is provided with drafting, photo interpretation, and office equipment which it transports with its three vehicles and trailers.

Geodetic Survey Team (TOE 5-540-IB)

The geodetic survey team is designed and equipped to provide precise survey support in areas of operations where survey control is limited or nonexistent. This team will be assigned to a topographic battalion and will establish primary survey control networks to serve as a base for further extension of control by topographic and artillery units.

This team is capable of establishing precise position, elevation, and azimuth control using the same methods and procedures employed by the survey company. The team evaluates existing control or establishes a control network to the accuracies required for further extension by the units in direct support of weapon systems.

The team is commanded by a topographic engineer with survey evaluation and planning being conducted by two additional topographic engineers and a survey technician. The team has surveyors, a draftsman, a clerk, and a survey instrument repair specialist assigned to accomplish its mission; and limited administrative and technical maintenance support. All other administrative, maintenance, messing, and supply functions will be provided by attachment to the supported unit.

Survey Team (TOE 5-540-IC)

The team is directed and supervised by a survey technician and is deployed in support of special operations conducted within the theater area. It is equipped and capable of extending control to support artillery surveyors with position, elevation, and azimuth necessary to control artillery firing points.

The team does not have assigned support personnel. All maintenance, administrative, supply, and messing functions will be provided by attachment to the supported organization.

Photomapping Platoon (TOE 5-540-IF)

This platoon has the same structure as the cartographic company's photomapping platoon. See Chapter 2, Cartographic Company, for mission, organization, capabilities, equipment, and special considerations.

The platoon may be allocated to an engineer topographic battalion when mapping requirements exceed unit capabilities.

Map Reproduction Platoon (TOE 5-540-IG)

This platoon is organized, equipped, and has the same capabilities as the map reproduction platoon of the cartographic company except that it has additional personnel to conduct a two shift operation without augmentation. It is capable of reproducing revised maps, overprinting of existing maps, overlays, map substitutes, and terrain studies.

The platoon may be attached to the theater or corps cartographic companies when operational requirements dictate the need for additional press capacity. The platoon can also operate independently, provided it has administration and logistical support. This platoon requires the same special considerations and support requirements as described in Chapter 2.

Map Distribution Platoon (TOE 5-540-IH)

The map distribution platoon provides personnel and equipment for receipt, storage, issue, and distribution of maps and related map products at theater army and corps levels. A team chief supervises platoon operations and is assisted by the platoon sergeant. The platoon consists of supply, warehouse, and packaging-crating specialists. Unlike the storage and distribution platoon of the cartographic companies, the map distribution platoon is not equipped or staffed with automatic data processing (ADP) equipment or machine operators.

The platoon may be attached to the theater or corps cartographic companies or operate independently, provided it has administration and logistical support. The platoon requires the same special considerations and support requirements as described in Chapter 2.

Corps Terrain Team (TOE 5-540-IJ) *(Also Applies To Theater Army Terrain Team, TOE 5-336)*

Terrain teams collect, analyze, and disseminate terrain information and intelligence to support commanders. They provide standard terrain products such as cross-country movement and road and bridge studies prior to hostilities; and updated information once the battle begins. The terrain team is a primary source of information for the G2 in his intelligence preparation of the battlefield (IPB).

The key to terrain team operations is rapid response. The team is only effective if information is provided to the commander in time to influence his tactical decisions. The standard for terrain teams is to respond to fifty percent of all inquiries within four hours

**THE COMMANDER MUST HAVE
INFORMATION IN TIME TO INFLUENCE
THE BATTLE**

and to the remainder, including those requiring a graphic presentation, within 48 hours.

Military geographic information (MGI) includes both natural and cultural terrain features. In order to provide rapid response, the terrain team stores MGI in data bases. The three data bases which contain MGI are:

**TERRAIN TEAM TECHNIQUES
ARE GEARED FOR RAPID
RESPONSE**

- 1** Special Purpose (SP) subset of the Thematic Graphic Data Base (TGDB)—a collection of graphic materials and associated data tables containing detailed terrain information. Examples are terrain factor overlays showing soil type and strength; and topic graphics showing cross-country movement conditions based on soil, vegetation, and slope.

This data base is stored in the storage, retrieval, and distribution (SRD) set of the cartographic company.

**DATA BASE IS A COLLECTION
OF INFORMATION STORED FOR
FUTURE USE**

- 2** MGI Data Base (MGIDB)—a collection of terrain information not converted to the TGDB. It may contain books, reports, and tabular data and is stored in the information section of the terrain team.
- 3** Imagistic Data Base (IDB)—contains remote-sensed imagery from all sources. This data is stored in the SRD set of the cartographic company.

In addition, the point positioning data base (PPDB) stored by the survey company at theater army is used with the terrain team's analytical photogrammetric positioning system (APPS) to determine geodetic positions, elevations, and quantitative terrain data. Terrain factor overlays and data bases are discussed in greater detail in FM 21-32.

Employment

The theater army and corps terrain teams have nearly the same organization, personnel, and equipment. The theater army team is part of headquarters and headquarters company, engineer topographic battalion (TOE 5-336); while the corps terrain team is separately organized under TOE 5-540-IJ and assigned to the topographic battalion on a basis of one per supported corps. The structure of these teams is shown in figure 3-1.

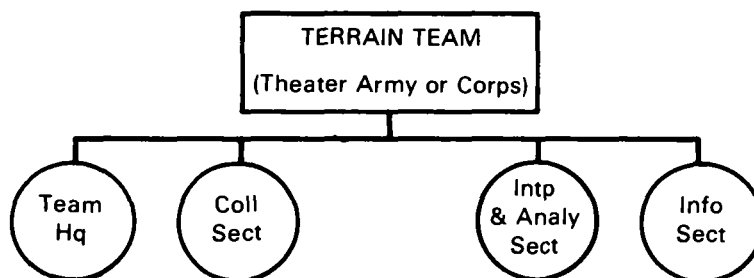


Figure 3-1. Terrain Team, Theater Army or Corps.

The theater army team provides general support to theater elements and is located with the battalion headquarters and headquarters companies. The corps terrain teams provide direct support and are located near the corps rear. The corps team works closely with the corps direct support cartographic company which assists the team's production and provides dining facilities and the use of its motorpool.

The corps terrain team locates four to seven analysts in the operations center of the corps ~~Electronic Warfare and Intelligence~~ *ASAC* → Operations Center (EWIOC) to provide direct response to critical intelligence/operational needs. The exact number and source (within the team) of these personnel will be determined by the terrain team commander based on unit requirements. A truck-mounted shelter is provided for this element.

The corps team has one division terrain team (TOE 5-540- IK) assigned per division in the corps areas. The corps team leader oversees and coordinates division team activities.

Task and Structure

By extracting information from the data base and updating it with the latest changes, the team responds to commander requests by preparing verbal responses, reports, listings, overlays, or other graphics. The type of response is governed by the nature of the request; the preparation time available; and the needs of the commander.

Generally, the terrain team operations are divided into five phases:

- Collection
- Analysis
- Information Storage
- Synthesis
- Dissemination

The 25-man theater army and corps terrain teams are structured around the five phases: the collection section obtains information; the interpretation and analysis section performs both the analysis and synthesis functions; and the information section stores analyzed data. A team headquarters supervises operations and, through the information section and the SRD section of the cartographic company, disseminates terrain information.

TEAM HEADQUARTERS

Headed by a terrain intelligence officer, the headquarters provides administration, operational planning, and control. Normally, the senior terrain intelligence

officer in the topographic battalion heads the theater army team. Other headquarters personnel are another terrain intelligence officer, a senior noncommissioned officer, and a clerk.

Tasks for the team headquarters are:

<i>Theater Army Team</i>
• Advising battalion commander and S3 (or supported unit commander) on terrain
• Supervising and coordinating activities of corps terrain teams
• Planning, scheduling, directing team operations
• Coordinating administrative and logistic support
• Coordinating with other terrain/intelligence agencies
• Editing team products

<i>Corps Team</i>
• Advising G2, G3, and engineer on terrain matters
• Supervising and coordinating activities of division terrain teams
• Planning, scheduling, directing team operations
• Coordinating administrative and logistic support
• Coordinating with other terrain/intelligence agencies
• Editing team products

COLLECTION SECTION

This eight-man section consists of terrain intelligence officers, enlisted terrain analysts, and enlisted topographic surveyors. It operates from the collection module—a trailer-mounted set containing office, drafting, and data collection equipment. The major collection sets are:

- **Hydrologic survey set**
- **Meteorological set**
- **Soil trafficability test set**

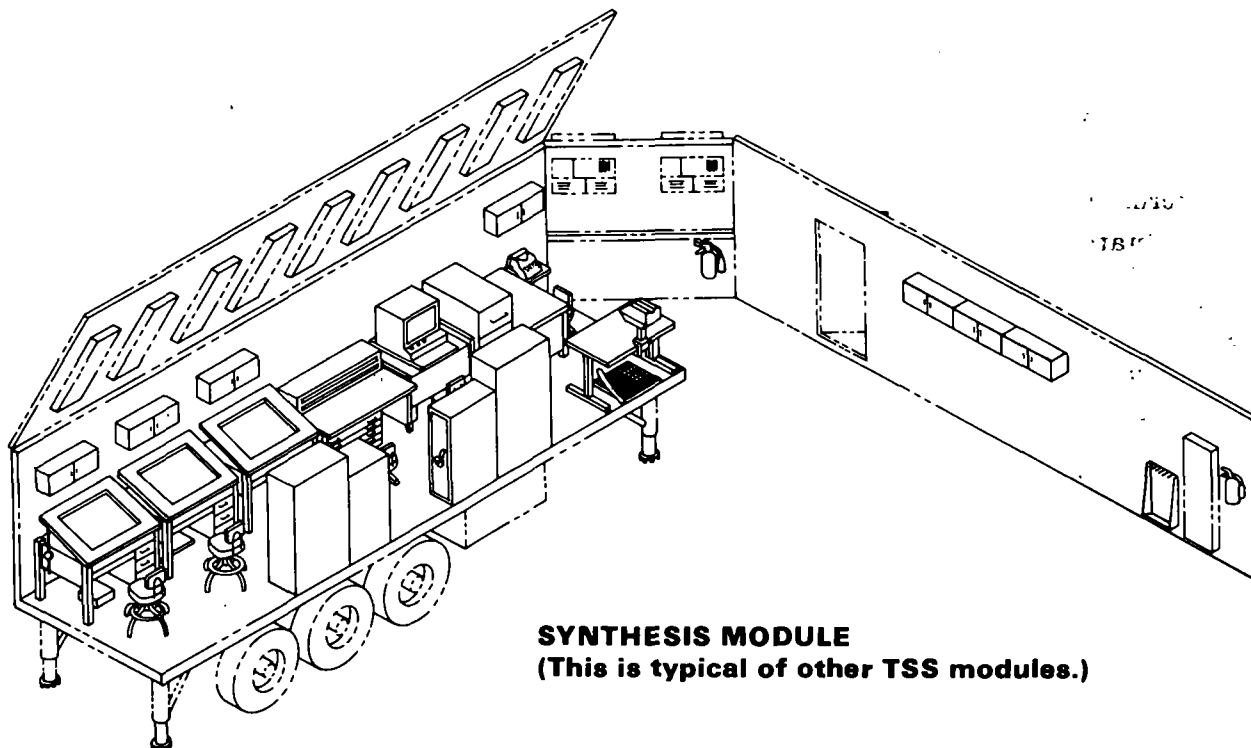
The task of the collection section is to procure terrain information from all sources. This task is continuous: started in peacetime and continued in wartime. The information is in various formats including reports, texts, journals, studies, remote-sensed imagery, interviews, graphics, or automated data. The sources of information are the Defense Mapping Agency, and other terrain/intelligence agencies, libraries, commercial firms, schools, indigenous personnel, prisoners of war, US and allied units, and direct observation/measurement (using team equipment).

The section operates in two modes: it sorts and passes to the interpretation and analysis section general information concerning the area of interest obtained through regularly received reports and publications; or, it researches and collects information for a specific project through other agencies or by direct measurement.

Whenever possible, the terrain team uses the collection capabilities of other engineer and intelligence units in the area. Theater team data collection requests are normally forwarded through the topographic battalion S2/S3 to the ENCOM ACSI or theater army G2; and corps team requests are forwarded through the corps G2. The collection section prepares these intelligence collection requests.

INTERPRETATION AND ANALYSIS SECTION

Operating from two trailer-mounted sets, the analysis and synthesis modules, the interpretation and analysis section prepares information to be stored in the data bases and extracts information from the data bases to prepare replies or products.



SYNTHESIS MODULE
(This is typical of other TSS modules.)

The section consists of officers with training in geology and hydrology, enlisted specialists in terrain analysis and soils, and a clerk. Its two modules contain photointerpretation equipment and have a limited reproduction capability for overlays. Major equipment for each module includes:

ANALYSIS
• Film Viewing Light Table
• Reflecting Projector
• Soil Test Set
• Diazo Printer
• Programmable Calculator
• Planimeter (Digitizer)
• Zoom Stereoscope
• Analytical Photogrammetric Positioning System (APPS)
SYNTHESIS
• Reflecting Projector
• Diazo Printer
• Planimeter (Digitizer)

In the analysis module, the section:

- Prepares supplemental factor overlays for the SP subset of the TGDB, using information extracted from the other data bases and newly collected information.
- Evaluates MGI provided by the collection section and prepares it for inclusion in the MGI data base.
- Reviews remote-sensed imagery provided by the collection section.

In the synthesis module, the section compiles special purpose products or prepares responses to terrain inquiries.

INTERPRETS AND ANALYZES STORED AND NEW INFORMATION

The special purpose products are prepared in manuscript format as either overlays or overprints to topographic maps. If wide distribution of the product is required, the manuscripts are transferred to the supporting cartographic company for reproduction. If distribution is limited, overlays are duplicated with the Diazo printer.

Quick responses are prepared as radio, telephone, or teletype answers to specific questions or as texts, listings, or tables.

In preparing responses and manuscripts, the section extracts available information from the various data bases and

supplements it with the latest data available from the collection section.

INFORMATION SECTION

The information section is staffed with a topographic engineer, three terrain analysts, and a clerk. It operates from trailer-mounted information modules containing storage and library equipment.

The information section stores the MGI data base and transmits replies to minor requests which do not require analysis by the interpretation and analysis section. It can also reproduce limited quantities of overlays and graphics.

Special Considerations

- *Mobility*— The terrain teams are not authorized truck tractors to move their trailer-mounted modules. Transportation support must be obtained through the supported commander.
- *Communications*— Channels of communication are necessary for the facsimile transmitting and teletype equipment in the collection sections of the corps and theater teams; and for transmitting data to and from the division teams. The MGI data base must be continually corrected, as the battle progresses, with information from terrain and intelligence units.

Tactical Operations

Team members have individual weapons only and cannot provide a unit defense. The team can provide guards for rear area security, but these duties severely limit the team's effectiveness.

Division Terrain Team (TOE 5-540-IK)

The division terrain team is a five-man unit providing direct support to each division. One division terrain team is assigned to the corps team per supported division.

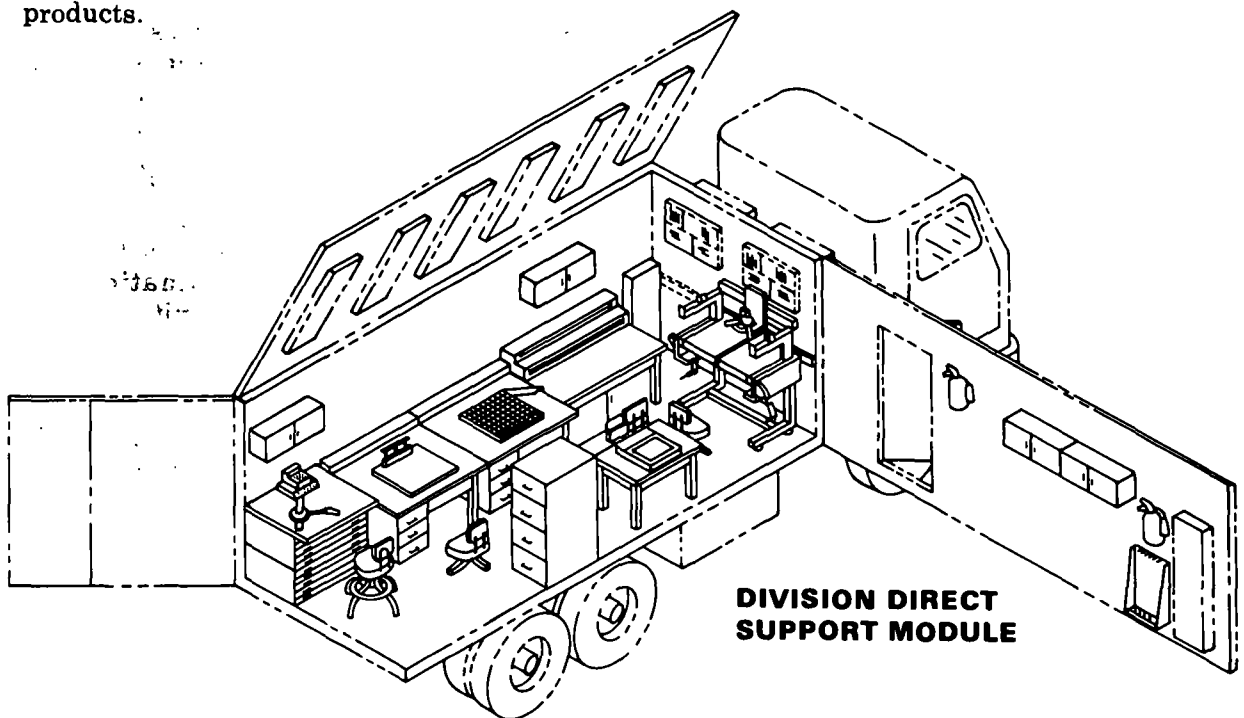
The division team acquires information for and from the collection section of the corps team and maintains communications with the information section in order to advise the division staff of changing terrain information.

The team works under the general staff supervision of the division G2 with special staff cognizance of the division engineer. It is located in the EWIOC and assists in the intelligence preparation of the battlefield, using the all-source information available to the EWIOC and the corps terrain team. It also maintains a limited stock of prepared nonstandard topographic products of the division area. The terrain team does not participate in the requisition and distribution of standard topographic products.

Summarized tasks of the division team are to:

- Provide MGI for the division G2's IPB
- Maintain communications with the corps team information section
- Collect information for the corps team collection section
- Stock limited quantities of nonstandard products
- Coordinate graphic support through the corps terrain team and cartographic company
- Advise the division commander and staff on terrain matters

The team is composed of a terrain intelligence officer, two noncommissioned officer terrain analysts, a cartographic draftsman, and a clerk. It operates from a module containing photointerpretation, drafting, and office equipment, and a Diazo printer for reproducing limited quantities of overlays and graphics.



The division terrain team is attached to the supported division for administration and logistics. Team members are equipped with individual weapons only and cannot provide a unit defense.

Survey Platoon (TOE 5-540-IL)

THE SURVEY PLATOON PROVIDES NECESSARY AUGMENTATION TO THE THEATER COMMANDER

This survey platoon is the augmentation platoon provided to a survey company, if required, for a four corps theater army. It is designed, equipped, and has the same capabilities as the survey platoons assigned to the survey company.

The survey platoon may also be employed to reinforce other survey teams if their mission exceeds organic resources or is subjected to time constraints.

The same special considerations, as outlined for the survey company, should be considered in the employment of this platoon.

CHAPTER 4

Topographic Training**GENERAL**

The Army Training and Evaluation Program for engineer topographic units (ARTEP 5-335) provides detailed guidance for conducting and evaluating unit training. This chapter supplements that guidance.

CONTENTS

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Technical Training	4-2

TECHNICAL TRAINING

Technical training is integrated into the daily peacetime operations of a topographic unit. During production, the unit's warrant and noncommissioned officers supervise on-the-job training.

PRODUCTION IS TRAINING

Since training and production are concurrent, unit leaders are able to continually perform internal evaluation of the ARTEP technical tasks. Weaknesses are easily identified when editors find errors or when production schedules are not met. Training programs can then be directed toward those weaknesses. Technical training is achieved by these informal, on-the-job methods or with more formal programs such as:

- | |
|--|
| • Classes taught by warrant officers and senior noncommissioned officers |
| • Mobile training team visits from the Defense Mapping School |
| • Individual attendance at Defense Mapping School courses |

On-the-job technical training is the most effective means since it correlates the training directly with the unit's mission and emphasizes performance-oriented training.

Training to Support the Commander

RESPONSIVE TACTICAL SUPPORT IS THE KEY TRAINING OBJECTIVE

The topographic unit's value is directly related to how rapidly and effectively it supports the tactical commander. The only way to evaluate this support mission is in a field situation.

It is important that unit training objectives be geared toward the support mission. Ideally, the topographic unit

participates in all field training and command post exercises conducted by the supported command. The unit commander evaluates not only the individual ARTEP tasks but also the overall performance of the unit in terms of effective support.

Nontechnical Training

Topographic troops are soldiers first, technicians second. The emphasis on technical training in topographic units should not override the common unit and tactical skills listed in the ARTEP. There are several of these common tasks which topographic units must stress:

- ***Operations in an electronic warfare environment.*** The ability to transmit terrain information despite enemy electronic warfare is critical to the terrain team's battlefield operations. Team personnel must be skilled in communication techniques and these skills must be tested during field exercises.
- ***Conducting unit movements.*** Topographic units require extensive transportation support to move. The high demand on transportation in theater and corps areas requires that moves be well rehearsed and coordinated. In addition, the units must be able to quickly prepare their modules for movement. These requirements can be met only through practice.
- ***Establishing an operations site.*** The size of topographic modules (semitrailer mounted) makes it difficult to locate them in the proximity required for efficient technical operations while maintaining tactical requirements for dispersal and concealment. Practice should be given in selecting and preparing sites in urban and rural settings. Training in camouflage techniques for the module is especially critical.
- ***Tactical training.*** Since topographic units do participate in the supported headquarter's rear area defense plan, training with individual weapons, perimeter guard procedures, and organization for defense should be a part of the unit's field exercises.

Training for the topographic unit is best in a field environment. By participating in supported unit exercises, the unit gains tactical realism and encounters planning and coordinating problems typical of battlefield operations. Whether or not there are supported unit exercises, the topographic unit conducts field training at least quarterly.

Evaluation

Internal evaluation takes place continually in topographic units. External evaluation is conducted when the unit participates in an exercise conducted by its supported unit.

External evaluation must be conducted by trained topographic personnel. Disinterested evaluation teams can be obtained from other topographic battalions or from topographic planning and control teams.

Training Assistance

Technical training assistance is available through mobile training teams provided by the Defense Mapping School. These teams are tailored to meet a unit's specific training needs and are available to Active, Reserve, and National Guard units upon request.

REFINEMENT OF INDIVIDUAL SKILLS

+

TRAINING OF UNIT LEADERS

+

TEAM COORDINATION

+

TACTICAL REALISM

= UNIT TRAINING

APPENDIX A**REFERENCES****STANDARDIZATION AGREEMENTS (STANAG)**

2022	<i>Intelligence Reports</i>
2201	<i>Standard Unit of Vertical Measure Shown on Land Maps</i>
2202	<i>Map Conventional Signs</i>
2205	<i>Use of Identical Maps by NATO Armed Forces Operating on Land</i>
2210	<i>Trig Lists (Lists of Geodetic Data)</i>
2211	<i>Geodetic Datums, Spheroids, Grids and Grid References</i>
2213	<i>Indexes to Names on Land Maps (Map Gazetteers)</i>
2215	<i>Evaluation of Land Maps</i>
2216	<i>Vertical Aerial Cartographic Photography</i>
2251	<i>Scope and Presentation of Military Geographic Information and Documentation (MGID)</i>
2253	<i>MGD - Roads and Road Structures</i>
2254	<i>MGD - Navigable Inland Waterways</i>
2255	<i>MGD - On Ports</i>
2256	<i>MGD - Inland Hydrography</i>
2257	<i>MGD - Railways</i>
2259	<i>MGD - Terrain</i>
2260	<i>MGD - Electric Power</i>
2263	<i>MGD - Coastal Areas and Landing Beaches</i>
2269	<i>MGD - Engineer Resources</i>
2271	<i>MGD - Urban Areas</i>

STANAG (cont)

3189	<i>Titling of Air Reconnaissance, Air Survey and Mapping Imagery</i>
3408	<i>Position Reference Systems for Aeronautical Charts</i>
3409	<i>Projections for Aeronautical Charts</i>
3412	<i>The Colour and the Minimum Aeronautical Overprint for Topographic Aeronautical Charts</i>
3591	<i>Criteria for Maximum Elevation Figure for Topographic Aeronautical Charts</i>
3600	<i>Topographic Land Maps and Aeronautical Charts 1:250,000 for Joint Operations</i>
3671	<i>Edition Designation System for Land Maps, Aeronautical Charts and Military Geographic Documentation</i>
3672	<i>Indexes to Series of Land Maps and Aeronautical Charts and Indexes to Military Geographic Information and Documentation (MGID)</i>
3675	<i>Symbols on Land Maps, Aeronautical Charts and Special Naval Charts</i>
3676	<i>Marginal Information on Land Maps and Aeronautical Charts and Photo Maps</i>
3677	<i>Standard Scales for Land Maps and Aeronautical Charts</i>
3689	<i>Place Name Spelling on Maps and Charts</i>
3690	<i>Standard Printing Sizes for Maps of Various Scales</i>
3710	<i>Military City Maps</i>
3716	<i>Map Series Numbering</i>
3721	<i>Automatic Data Processing (ADP) Master File for Maps and Aeronautical Charts</i>
3754	<i>Automatic Data Processing (ADP) War Reserve Stock File for Maps and Aeronautical Charts</i>

FIELD MANUALS (FM)

5-1	<i>Engineer Troop Organizations and Operations</i>
5-30	<i>Engineer Intelligence</i>
5-35	<i>Engineer's Reference and Logistical Data</i>
5-36	<i>Route Reconnaissance and Classification</i>
6-2	<i>Field Artillery Survey</i>
21-6	<i>How to Prepare and Conduct Military Training</i>
21-26	<i>Map Reading</i>
21-30	<i>Military Symbols</i>
21-31	<i>Topographic Symbols</i>
21-32	<i>Topographic Support</i>
21-33	<i>Terrain Analysis</i>
24-1	<i>Combat Communications</i>
30-5	<i>Combat Intelligence</i>
30-10	<i>Military Geographic Intelligence (Terrain)</i>
(C) 30-10A	<i>Special Applications of Terrain Intelligence</i>
31-35	<i>Jungle Operations</i>
31-71	<i>Northern Operations</i>
32-30	<i>EW, Tactics of Defense</i>
90-3	<i>Desert Operations</i>
100-5	<i>Operations</i>
101-5	<i>Staff Officers' Field Manual, Staff Organization and Procedures</i>
101-10-1	<i>Staff Officers' Field Manual, Organizational, Technical and Logistical Data - Unclassified Data</i>

TECHNICAL MANUALS (TM) WITH TOPOGRAPHIC INFORMATION*

5-232	<i>Elements of Surveying</i>
5-233	<i>Construction Surveying</i>
5-235	<i>Special Surveys</i>
5-236	<i>Survey Tables and Graphs</i>
5-237	<i>Surveying Computer's Manual</i>
5-240	<i>Compilation and Color Separation of Topographic Maps</i>
5-241-1	<i>Grids and Grid References</i>
5-241-8	<i>Universal Transverse Mercator Grid</i>
5-243	<i>Cartographic Aerial Photography</i>
5-245	<i>Offset Photolithography and Map Reproduction</i>
5-248	<i>Foreign Maps</i>
5-441	<i>Geodetic and Topographic Surveying</i>
5-442	<i>Precise Astronomic Surveys</i>
5-443	<i>Field Classification Surveys</i>
(C)30-245A	<i>Image Interpretation Handbook - Vol 2 (U)</i>
30-246	<i>Tactical Interpretation of Air Photos</i>

ARMY REGULATIONS (AR)

115-11	<i>Army Topography</i>
310-1	<i>Military Publications (General Policies)</i>
310-3	<i>Military Publications (Preparation, Coordination and Approval)</i>
350-1	<i>Army Training</i>
380-Series	<i>Security</i>
381-Series	<i>Military Intelligence</i>
725-50	<i>Requisitioning, Receipt, and Issue System</i>

*Excluding equipment maintenance and repair manuals.

TABLES OF ORGANIZATION AND EQUIPMENT (TOE)

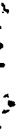
5-335H	<i>Engineer Topographic Battalion, Theater Army</i>
5-336H6	<i>Headquarters and Headquarters Company, Engineer Topographic Battalion, Theater Army</i>
5-337H6	<i>Cartographic Company, Engineer Topographic Battalion, Theater Army</i>
5-338H6	<i>Survey Company, Engineer Topographic Battalion, Theater Army</i>
5-540H3	<i>Engineer Topographic and Intelligence Teams</i>

JOINT CHIEFS OF STAFF PUBLICATIONS (JCS)

JCS Pub 1	<i>Dictionary of United States Terms for Joint Usage</i>
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DEPARTMENT OF DEFENSE REGULATIONS AND MANUALS (DOD)

DOD-DMATC	<i>Glossary of Mapping, Charting and Geodetic Terms</i>
DOD-DMATC Manual S-1	<i>Specifications for Military Maps</i>
DOD-DMATC Manual 1-40130	<i>Quality Control Manual</i>
DOD-DMA	<i>Catalog of Maps, Charts and Related Products</i>



APPENDIX B**GLOSSARY**

This glossary contains nontechnical explanations of topographic terms and equipment nomenclature used in this manual. For exact definitions, see the Department of Defense Glossary of Mapping, Charting and Geodetic Terms prepared by the Defense Mapping Agency Topographic Center; AR 310-25, Dictionary of Army Terms; or the manuals referenced in Appendix A.

AMMONIA PROCESS PRINTING AND DEVELOPING MACHINE

This machine is a standard commercial product which produces monochrome contact prints or transparencies up to 42 inches in width from transparencies.

ANALYTICAL PHOTOGRAMMETRIC POSITIONING SYSTEM (APPS)

A desk-top stereographic viewer with attached computer, used with the point positioning data base (PPDB) to quickly find universal transverse mercator (UTM) or geographic coordinates and elevations of a point on the earth.

ANALYTICAL STEREOPLOTTER (ASP)

This is a photogrammetric instrument designed to produce topographic maps and digital terrain elevation data. The ASP consists of a two-stage 9" x 9" or larger frame format for aerial photo negatives; stereoscopic viewer; plotting table; and electronic controller with computer. The ASP will generally accommodate any focal length, film size, flight height or distortion. It differs from analog stereoplotters where these variables must be within the specifications of the equipment.

ARMY TERRAIN INFORMATION SYSTEM (ARTINS)

An automated data storage, retrieval, and processing system containing terrain information in digital and microminiaturized graphic form. It will be kept in the Information Module of the theater army and corps terrain teams. This system currently is in the research and development cycle and its configuration and placement are conceptual.

ARTINS

See Army Terrain Information System.

ASTRONOMIC AZIMUTH

The azimuth (measured 0-360. from astronomic north) between two points on the surface of the earth determined by observation of the sun or stars. Used to start or end a survey when no previously established azimuth exists or when existing azimuths do not meet the accuracy requirements of a project (TM 5-441).

ASTRONOMIC POSITION

The latitude and longitude of a point on the surface of the earth determined by observing stars. Used to start surveys when no other position exists or to provide a check of the validity of a survey project (TM 5-441).

CARTOGRAPHY

The art and science of portraying physical and man-made features of the earth graphically, usually as a map or chart (TM 5-240).

COLOR PROOF

A composite of all colors represented on a particular map, photomechanically placed on a plastic sheet. A quality control process used by battalion edit or photomapping platoon, prior to actual reproduction of the map (TM 5-245).

COLOR SEPARATION

Color separation is a phase in the map making process in which a separate negative is produced for each color from a compilation manuscript. This is necessary because a separate plate is required for each color on the offset printing press (TM 5-240).

COMPILATION

The process of drawing a topographic product using existing maps, aerial photographs or other sources of information using either manual techniques or mapping equipment (TM 5-240).

COMPILATION MANUSCRIPT

The compilation manuscript consists of cultivated vegetation, hydrographic, and relief features of a portion of the earth's surface drawn to a selected scale and specification. This is usually performed on drafting film with colored pencils and drafting instruments (TM 5-240).

CONTROLLED MOSAIC

A mosaic oriented and scaled to horizontal ground control, it consists of rectified aerial photographs (photographs which have been re-exposed on a rectifier having the capability of removing distortion due to tip and tilt of the original camera station). This is the most accurate type of mosaic except for the orthophoto mosaic (TM 5-240).

CROSS-COUNTRY MOVEMENT

The movement of military vehicles (usually tactical) across terrain without using roads and bridges (FM 30-10).

DATA BASE

A collection of information in any form, assembled for a particular future use.

DENSIFICATION

The establishment of survey control points within an area where a limited number of control points previously existed (TM 5-441).

DIAZO PRINTER

See Ammonia Process Printing and Developing Machine.

DIFFERENTIAL LEVELING

The determination of the elevation of a point on the earth's surface by the direct measurement of the differences in elevation between the point and a known point of elevation. The most precise elevation (method) used by surveyors (TM 5-441).

EXTENSION OF CONTROL

The act of extending the position and/or elevation of an existing survey control point to a point of unknown position and/or elevation (TM 5-441).

FACSIMILE TRANSMITTER

A device used to send copies of photographs, maps, or other graphics over voice circuits, receiving a permanent copy at the other end (FM 24-1).

FACTOR OVERLAY

An overlay to a map base which uses lines, textural areas, symbols, or their combination to delineate a particular type of information. For example, a soil factor overlay may have lines and symbols which show soil types. Factor overlays are the principal components of the Thematic Graphic Data Base (TGDB).

FILM VIEWER (PORTABLE)

This instrument is designed for viewing up to 9-inch wide aerial photographic film negatives. Film is mounted on reels and cranked across a light table for viewing and inspection.

GEODETIC CONTROL

A system of horizontal and/or vertical survey control points that have been established and adjusted by geodetic methods in which the shape and size of the earth have been considered (TM 5-441).

GYROSCOPIC INSTRUMENTS

A survey instrument attached to a north seeking gyroscope used for the determination of true north. Provides the surveyor with the capability of determining an azimuth in all weather conditions. Issued to each survey platoon within a survey company (TM 5-441).

HALFTONE

An image in which detail and tone values are represented by a series of evenly spaced dots of varying size and shape (TM 5-245).

HORIZONTAL CONTROL

Survey control points on which the horizontal coordinates have been determined. The coordinates may be either geographic (latitude and longitude) or grid (TM 5-441).

HYDROLOGIC SURVEY SET

A set of equipment consisting of stream gaging and depth measuring devices.

IDB

See Imagistic Data Base,

IMAGISTIC DATA BASE (IDB)

A collection of remote-sensed imagery including side-looking airborne radar, multispectral, infrared, and black and white photographs taken with mapping and reconnaissance camera systems. It is kept in the cartographic company's storage and retrieval and distribution modules.

INTELLIGENCE PREPARATION OF THE BATTLEFIELD (IPB)

A technique in which intelligence and doctrinal templates are used in combination to analyze enemy courses of action. Usually prepared by the G2, it requires terrain information input from the supporting terrain team.

INTERACTIVE GRAPHIC SYSTEM

The major components of this system are a digitizer, a processor, an edit station, and an output plotter. The digitizer scans the compilation manuscript and records this data; the processor is a computer that transforms this digital data into desired drafting specifications; the edit station is a cathode-ray tube which displays data in final format for editing. Upon final edit, color separated sheets are drafted by the output plotter.

IPB

See Intelligence Preparation of the Battlefield.

LEVELING

The determination of the elevation of a point of the surface of the earth (TM 5-441).

LITHOGRAPHY

A method of printing based on the chemical repulsion between grease and water to separate the printing from nonprinting areas (TM 5-245).

MANUSCRIPT

A drawn graphic, usually prepared as an overlay to a base map, which shows information to be placed on a map product.

MGI

See Military Geographic Information.

MGI DATA BASE

A library of books, periodicals, reports, and tables which have not been converted into a symbolized format suitable for inclusion in the special purpose subset of the Thematic Graphic Data Base.

MGIDB

See MGI Data Base.

MILITARY GEOGRAPHIC INFORMATION (MGI)

Terrain information which has been processed into a form usable for preparing intelligence. Examples are military bridge classifications and cross-country movement overlays. MGI is prepared by intelligence and engineer units.

MOSAIC

A mosaic in photogrammetry is the assembly of two or more overlapping aerial photographs whose edges usually have been torn or cut, and matched to form a continuous photographic representation of a portion of the earth's surface. Mosaics are referred to as hasty map products which can be used as map supplements or substitutes. Their information is more current than topographic maps but usually less accurate in scale.

NEGATIVE ENGRAVING

This is the most common way that color separation is accomplished. It requires the use of scribecoat, which is a thin piece of clear film (24" x 30" x .007") covered on one side with an opaque coating. This coating is removed with engraving tools called "scribers," creating a negative. Another material used is peelcoat

which is much like scribecoat. However, the coating is removed with stencil knives. Scribecoat is used for line work and peelcoat for larger open areas such as water and vegetation areas. This task is performed on light tables (TM 5-240).

NONSTANDARD PRODUCTS

Topographic products tailored for a particular purpose or for a particular use, usually not prepared to a standard specification. These products may or may not be assigned a stock number and incorporated into the map distribution system, depending on their anticipated use.

OFF-LINE ORTHOPHOTO PRINTER

Either coupled with an analytical stereoplotter or with a digital tape, this instrument can print high resolution rectified photos and orthophotos from vertical and oblique frame and panoramic photography.

OFFSET PRINTING

An indirect method of printing whereby the ink image is transferred (offset) from the press plate to an intermediate surface of a rubber blanket and from that to the paper (TM 5-245).

ORTHOPHOTOMAP

This is a photomap constructed of orthophotographs (photographs in which the displacements of images due to tilt and relief have been removed). This is the most accurate photomap (TM 5-240).

OVERLAY

Transparent film, drafting film, or tracing paper with specific data portrayed. Overlays are used in the compilation phase of the map making process or may be an end product used to overlay an existing map or map product (TM 5-240).

OVERPRINT

New information printed upon a map, usually in purple, to show data of importance or special use, in addition to that originally printed (TM 5-245).

PHOTOCOMPOSING MACHINE

This machine is used to prepare type (printer matter) appearing on a map. The type is made on photographic film which is placed on an overlay to the map features and marginal data format.

PHOTOGRAMMETRY

The process of making precise measurements and plotting features accurately by use of aerial photography and stereoplotters (TM 5-244).

PHOTOMAP

Map substitute or supplement consisting of an aerial photo mosaic to which a grid, marginal information, contours, place names, and other data may be added (TM 5-240).

PHOTOMECHANICAL

A reproduction process combining photographic and mechanical operations (TM 5-245).

PLANIMETER (DIGITIZER)

A table-top system which provides a digital display of the position of a cursor as it moves across the surface; used to measure distance and area on aerial photography.

PLATEMAKING Photomechanically placing an image on a photosensitized thin metal sheet, whose surface is treated to make only the image areas ink receptive (TM 5-245).

POCKET STEREOSCOPE

A binocular optical instrument for helping an observer to view aerial photographs as three-dimensional models. This instrument is used in map revision and terrain analysis (TM 5-240).

POINT POSITIONING DATA BASE (PPDB)

A set of materials consisting of aerial photography (for which the exact position of the camera in a reference system is known) and a data tape (containing the camera station reference system information). Both are used in the APPS to extract ground positions in UTM or geographic coordinates.

PPDB

See Point Positioning Data Base.

RECAST

This is a method of making a new map from existing map reproducibles or portions of reproducibles of two or more adjoining map sheets. Depending on the request, this can be a hasty product or a full revision (TM 5-240).

RECTIFIER

This is a precise, autofocus, vertical photoenlarger which permits the correction for distortion in vertical aerial photography due to tip and tilt of the taking aircraft. See controlled mosaic (TM 5-240).

REFLECTING PROJECTOR

An instrument which is used to project the image of photographs, maps, or other graphics onto a copying table. The scale of the projected image can be varied by raising or lowering the projector or copyboard depending on the model. There are also some reflecting projectors with tilting copyboards which compensate for tip and tilt distortion in aerial photographs. This instrument is used in map revision.

REMOTE-SENSED IMAGERY

The products of remote (usually airborne) sensing instruments which record electromagnetic spectrum missions. For example, a mapping camera records images of the earth below on film. Other sensing instruments are side-looking airborne radar and a variety of special purpose camera systems.

RICHARDS SPLIT STAGE LIGHT TABLE

This equipment allows for simultaneous viewing of various inputs (photos and maps) in superimposition. Used mainly for locating existing control, selecting and plotting of supplementary control, and feature identification on aerial photography.

SEMICONTROLLED MOSAIC

This is a mosaic constructed of rectified or unrectified photographs (see controlled mosaic) and laid to a common basis of limited ground control (TM 5-240).

SIC

See Survey Information Center.

SOIL TEST SET

A set of equipment consisting of sieves for measuring particle sizes in a soil sample, accurate scales, a laboratory drying oven, soil sample remolding equipment, and auxillary devices necessary to classify and determine bearing strength and optimum soil moisture content (TM 5-330).

SOIL TRAFFICABILITY TEST SET

A set of equipment consisting of a cone penetrometer, a soil sample cylinder, and remolding devices, used to determine the rating cone index of soils (TM 5-330).

SPECIFICATIONS

Rules, regulations, symbology, and a comprehensive set of standards which have been established for a particular map or group of maps. Specifications vary with the scale and purpose of the product.

STANDARD PRODUCT

A topographic product made to a standard specification and included in the Defense Mapping Agency list of approved products and services. Standard products are available through the DOD Map Distribution System.

SURVEY CONTROL NETWORK

An interconnected system of survey control points with the determination of position and elevation either completed or planned (TM 5-441).

SURVEY INFORMATION CENTER

The storage and maintenance of the coordinates, elevation, and descriptive data on survey control points within an area of operations. Usually maintained in the operations section of the survey company, Engineer Topographic Battalion (TA). Information is available to all users upon request.

TATSUP

See Theater Army Topographic Support Plan.

TERRAIN ANALYSIS

The process of interpreting a geographic area to determine the effect of the natural and cultural features on military operations. This includes the influence of weather and climate on those features.

TERRAIN INFORMATION

Information concerning natural or cultural terrain features in unprocessed form. Examples are road, bridge, and soil trafficability measurements. Terrain information is collected on site by all units in an area of operations and from remote-sensed imagery and collateral sources (FM 30-10).

THEATER ARMY TOPOGRAPHIC SUPPORT PLAN (TATSUP)

A plan which identifies shortfalls in topographic support, keyed to any war or contingency plan, and providing for elimination of the shortfalls (FM 21-32).

THEMATIC GRAPHIC DATA BASE (TGDB)

An accumulation of reproducible materials (usually photo negatives or film positives) required for the reproduction of topographic products. It has two subsets: general purpose, containing reproducibles for standard maps; and special purpose, containing terrain information prepared in an overlay format. It is kept in the storage, retrieval and distribution module of the cartographic company.

TMICP

See Topographic Map Inventory Control Point.

TOPOGRAPHIC MAP INVENTORY CONTROL POINT

A map depot, usually in the COMMZ, which maintains an automated inventory control system for maps and transmits inventory, issue, and receipt data by automatic digital network (AUTODIN) to the Defense Mapping Agency.

TOPOGRAPHIC SUPPORT SYSTEM (TSS)

A modular set of topographic equipment consisting of survey, cartographic, reproduction, and MGI subsystems. The modules are either van or trailer mounted. A detailed description of the modules can be found in FM 21-32.

TOPOGRAPHIC SURVEY

A survey showing the determination of relief and location of natural and cultural features on the surface of the earth (TM 5-441).

TOPOGRAPHY

As used in the Army, this term includes charting, geodesy activities and terrain analysis, plus the disciplines of survey, cartography, terrain analysis, and the skills of reproduction (AR 115-11).

TRAVERSE

A method of survey where the distances and directions between points on the earth's surface are obtained from field measurements. From these measurements, the coordinates and elevations of the points are determined (TM 5-441).

TRIANGULATION

A method of survey which uses points on the surface of the earth as corners of geometric figures. The angles within these figures are measured and the distances between the points are derived by computation from selected measured sides or base lines (TM 5-441).

TRIGONOMETRIC ELEVATION

The elevation of a point determined by the measurement of the vertical angle and distance from a known point to the unknown point. The elevation is computed by trigonometric methods (TM 5-441).

TRILATERATION

A method of survey where the lengths of the sides of geometric figures are measured and the angles and positions of the points computed from these lengths. Compare with triangulation (TM 5-441).

TSS

See Topographic Support System.

UNCONTROLLED MOSAIC

A mosaic composed of unrectified prints and constructed by matching detail from print to print without ground control or other orientation. This mosaic can usually be constructed more quickly than the other types. However, it is the least accurate in scale and position (TM 5-240).

VERTICAL CONTROL

Survey control points for which the elevation of the point has been determined by leveling (TM 5-441).

ZOOM TRANSFER SCOPE

This instrument permits the superimposition of a photographic image over a map. Used for the revision of maps and related products, there are monoscopic and stereoscopic models of this instrument.



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The proponent for this field manual is the US Army Engineer School. Users are requested to send comments and suggested improvements to: Commandant, USAES, ATTN: ATZA-TDL, Fort Belvoir, VA 22060.

FM 5-146

28 SEPTEMBER 1979

By Order of the Secretary of the Army:

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Major General, United States Army
The Adjutant General

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